REPORT RESUMES

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TESTING THE EFFECTIVENESS OF TWO-PURPOSE TELEVISION PROGRAMS IN CONTRIBUTING TO BOTH TEACHER AND PUPIL LEARNING (ELEMENTARY SCIENCE).

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A SERIES OF TELECASTS WAS DESIGNED TO EDUCATE TEACHERS FOR BETTER SCIENCE TEACHING, AND TO STIMULATE GREATER PUPIL INTEREST IN SCIENCE. CONSULTATIONS WITH ADVISORS IN SCIENCE EDUCATION, TELEVISION, AND PUBLIC SCHOOL SUPERVISORS DEVELOPED PROJECT PLANS FOR 10 HALF-HOUR TELECASTS IN ELEMENTARY SCIENCE TO BE PRESENTED BIWEEKLY DURING THE SCHOOL DAY TO THIRD AND FOURTH GRADE CLASSES. PLANS CALLED FOR PROGRAMS TO (1) CONTAIN SUBJECT MATTER TO BE SELECTED IN PART BY THE TEACHERS AND BE CONSISTENT WITH CURRENT STUDY COURSES, (2) EMPHASIZE WAYS OF LEARNING (EXPERIMENTATION, OBSERVATION, ETC.), (3) BE PLANNED AROUND A TOPIC USING INSTRUCTIONAL MATERIALS TO STIMULATE SIMPLE EXPERIMENTATION, (4) EMPHASIZE CONCEPT FORMATION, AND (5) LEAD TO ADDITIONAL CHILD LEARNING EXPERIENCES. SUPPLEMENTARY TEACHER GUIDANCE MATERIALS WERE PROVIDED. EVALUATION PROCEDURES INCLUDED CLASSROOM OBSERVATION, A TEACHER ATTITUDE QUESTIONNAIRE, TEACHER INTERVIEWS, AND STANDARDIZED TESTS IN SCIENCE FOR THE PUPILS. CHECKLISTS OF BEHAVIORS IN SCIENCE WERE USED TO EVALUATE NOTICEABLE CHILD ATTITUDE CHANGES. TEACHER EVALUATIONS INDICATED TEACHERS (1) WERE MOTIVATED TOWARD BETTER SCIENCE TEACHING, (2) FOUND SPECIFIC WAYS TO IMPROVE TEACHING, (3) BENEFITED FROM THE TEACHERS' GUIDE BOOK, (4) THOUGHT EXTENSION OF TELEVISED LESSONS TO OTHER AREAS WOULD BE VALUABLE, AND (5) BELIEVED CHILDREN GAINED BOTH IN INTEREST AND KNOWLEDGE OF SCIENCE. (AL)

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THE OHIO STATE UNIVERSITY

RESEARCH FOUNDATION

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1 July 1959 - 31 December 1960

TESTING THE EFFECTIVENESS OF TWO-PURPOSE TELEVISION PROGRAMS IN CONTRIBUTING TO BOTH TEACHER AND PUPIL LEARNING (ELEMENTARY SCIENCE)

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Department of Health, Education, and Welfare
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REPORT

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For the period: 1 July 1959 - 31 December 1960

Submitted by: Alexander Frazier and
Lewis D. Evans
Center for School Experimentation
University Schools, The Ohio State University

Date: 27 December 1960

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Chapter I.

THE NATURE OF THE STUDY

Television as a medium of communication for extending and enriching the instructional program of pupils in the elementary and secondary schools is widely accepted and used in various ways for some form of in-school listening. However, many questions arise as school systems look into the in-service value of televised services for teaching personnel. Basically the question is one of purposes to be met, which in turn helps define the form and manner of programming such services by television. Also, as various curricular and in-service needs are clarified, there is the question of the scope of such programs. Can televised services be planned within the context of general concern for the needs of many teachers and still contribute to the needs of individual teachers? The question also arises as to when such services should be televised. Should programs for teachers be done after school or can they be planned for presentation some time during the teaching day? Is it possible that, for certain purposes, television programs could be conceived as contributing to teacher competency in an area of instruction and at the same time foster children's learnings?

This present project proposed to study the possibilites of such two-purpose use of television and defined these questions as relevant:

1. How effective can a series of televised programs on elementary school science be in increasing teacher understanding as well as stimulating pupil activity?

2. Can both purposes be simultaneously served?

3. What should be the pattern or design of such programs for children which are seen as intended to be of primary value to teachers?

4. Can such two-purpose programs be planned, produced, and evaluated with sufficient skill so that results will be useful in the planning of similar programs in other fields besides science?

If these questions could be critically examined, then the study might give added insight in to the possibilities of another avenue of communication to provide consultant services to teachers.

There is ample justification for studying the idea of two-purpose television. While much evidence is accumulating on the effectiveness of pupil-oriented television, little of a critical nature has been reported on the use of television for the in-service education of teachers.[1] Also much of what has been provided has come after school. One school with closed-circuit television facilities reports such a use to help teachers in the production and use of simple instructional materials in the classroom.[2] Reiner[3] reports the results of a study on the use of television toward improving primary grade science teaching. While the two-purpose idea is in evidence in this well-reported study, little attempt was apparently made to evaluate the attitudes of participating teachers toward science teaching before and after the telecasts as a measure of the possible effectiveness of the televised series.

It is also true that many school personnel responsible for the production of television programs for children have testified to their belief that some contribution has been made in teacher education, and that more "true" experimentation needs to be planned.[4] Teachers have also expressed similar feelings as to the indirect values of these programs toward providing some stimulus and guidance in improving their own teaching. However, these appraisals have been informal and unreported.

This latter point is of great importance in the fields of teaching and supervision, where the concern is to strengthen working relationships. This study should serve to give added insight into the problem of making a more complete use of centrally provided consultant services in in-service education, a need defined as one of the most pressing in the field of supervision.[5]

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[1] Early examples of in-service programs are reported by Lee E. Campion, "The Teacher Trains the Teacher," Educational Screen and Audio-Visual Guide, 35: 410-411, November, 1956; and Harold E. Wigren, "Television: A Challenge to the Elementary Schools," National Elementary School Principal, 35: 212-224, September, 1956.

[2] John Sheffer, "Closed Circuit Television for In-Service Training of Teacher," Overview, L: 62-63, April 1960.

[3] William B. Reiner, "The Effectiveness of a Television Series in Improving Kindergarten to Grade Two Science Teaching Programs," School Science and Mathematics, 59: 397, May 1959.

[4] Harold D. Drummond, "We Need More True Experimentation," Opportunities for Learning: Guidelines for Television, edited by Alexander Frazier and Harold Wigren. Washington: National Education Association, 1960, page 37.

[5] Marvin L. Berge and other, In-Service Education, The Fifty-Sixth Yearbook of the National Society for the Study of Education, Part I. Chicago: University of Chicago Press, 1957, pp. 197-223.

The problem of how to bridge the gap between such centrally-located services and the needs of the classroom teacher is one of growing concern. The expanding nature of school systems, both in terms of geographic units and increasing numbers of teachers, is making it increasingly difficult to utilise effectively the present methods of operation and communication. While individual teachers will always have special needs which can be met trhough small group participation or consultation, there is an increasing number of teachers who have certain common needs which are not being met. This is to be found in all areas of the curriculum where decisions for improvement are being implemented through centrally-provided services, but especially in certain areas of teaching and learning, where, because of the lack of professional training and/or general background of experience in the content area, teachers feel less prepared to provide the appropriate educational experiences.

This need becomes particularly pressing in the area of elementary science, not only because of the varied feelings of confidence of teachers toward planning and carrying on science experiences, but also because of the limited amount of consultant service being given and the small number of supervisors and principals who consider themselves properly prepared in elementary science.[6] If through television, ways to improve the teaching and learning of science can be provided classroom teachers, on terms acceptable to them and consistent with desirable supervisory practices, then the in-service or consultant service values of the use of the medium would be further clarified.

So far as is known, no studies have been attempted in the designing of television experiences for pupils that are seen as intended primarily for teachers with plans for assessment of changes in teacher values and attitudes toward the teaching of a content area. It is therefore believed that the results of this study will be closely studied.

The Center for School Experimentation, located in the University School on the campus of The Ohio State University, acted as the immediate agency for initiating the study and provided certain consultant services toward furthering its implementation and completion. The Center may also stand as representative of one type of centrally-located resource aid to teachers. Whatever is discovered that would suggest fuller use of laboratory school services presumably would also apply to the better use of existing central services in city and county systems.

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[6] Glenn Blough, editor, *It's Time for Better Elementary School Science*. Washington: National Science Teachers Association, 1958, page 27.

A. SPECIFIC OBJECTIVES OF THE STUDY

Specifically this study was addressed to the testing of the following hypothesis:

> A series of periodically provided telecasts can be designed for elementary school classroom use that will serve a double purpose: (1) to stimulate greater pupil interest in science and (2) to educate teachers for better science teaching.

In order to make a critical assessment of the value of televised services in science using the above suggested approach, it was necessary to study closely a number of interrelated factors. Teachers and children in the classroom were interacting to the same televised program. Teachers were studying the content for what it might contribute to their teaching. Children were individually observing and reacting to the content in terms of their own background of experiences in science, maturity level, and general interest in the area of science presented. Teachers also needed to be sensitive to the reactions of children as indices of interest and attitudes toward each telecast for use in planning further learnings in science. There was also the factor of the design of each telecast to provide the proper double stimulus of pupil interest and teacher information. The entire undertaking had to be placed within a framework of co-operative working relationships among teachers, administrators, and those carrying on the study.

In evaluating the effectiveness of the two-purpose approach, it seemed important to study the prevailing feelings of teachers toward science teaching and what these might suggest for planning televised consultant services. Teacher decisions toward accepting curriculum modifications or improving teaching techniques are dependent on their attitudes and general feelings of confidence with reference to any given area of learning. Each person perceives in himself, in terms of professional training and past experiences, what he can do for children in the total educative process. Some feel more secure than others in certain areas of instruction and interpret this general feeling through the kinds of teaching and learning going on in the classroom.

In the area of elementary science teaching, we especially find wide differences in teacher attitudes and feelings of confidence toward the subject areas. This is reflected in the range of approaches taken and the teaching processes used to foster meaningful learnings in science. It was not our purpose to go into the causes of the existence of such attitudes, but rather to recognize that they control behavior in teaching and are crucial in determining the over-all design of any kind of consultant service to teachers. If the attitudes can be identified and appropriate experiences to affect them planned and televised, perhaps some modification could be realized toward redefinition of existing concepts of science teaching.

The project therefore included a concern for several aspects of attitude relative to teaching science as indicated below:

1. The feelings of confidence of teachers toward carrying on certain kinds of learning experiences in science.

2. Attitudes toward the use of television to suggest approaches, processes, and materials teachers can use in developing science concepts.

3. Teacher-pupil reactions to each science telecast for indications of the extent to which dual purposes are being met.

B. PROCEDURES IN PLANNING FOR THE STUDY

In pursuit of these objectives, certain decisions had to be made on procedures for designing, developing, presenting, and evaluating the television series. Major questions to be answered included these:

1. What science subject matter content should be presented? Should more emphasis be placed on the physical or biological sciences?

2. What school grade level or levels to use?

3. What should be the length of time of each telecast?

4. What kinds of activities should be stressed and in what ways?

5. How frequently should programs be televised? At what hour of the school day?

6. What television facilities and services will be needed and their availability?

7. How should the televised materials be planned and produced to provide the intended services?

8. What methods of recording and evaluating each telecast and the series as a whole should be used?

9. Would it be advisable to pre-test and post-test certain groups of children as another index of the value of the televised services?

10. What kinds of supplementary materials should be provided teachers toward more effective utilization of the science telecasts?

The two-purpose use of television, to be effective, had to direct itself to both teacher needs and pupil interests. Interaction must be encouraged among children and between teacher and children. The design of all television programs had to be continually thought of in these terms.

After consultation with advisers to the study in the fields of science education and television at The Ohio State University and with administrative and supervisory personnel in nearby schools, the following decisions were reached as to the over-all conceptual design of the televisied science series:

1. Ten one-half hour telecasts in elementary science were to be presented during the school day, at biweekly intervals, to interested teachers of third- and fourth-grade children.

2. The specific subject matter content in science would be determined in part by the participating teachers and be consistent with existing courses of study and basic textual materials used by teachers in these grades.

3. The programs were to be seen as emphasizing ways of learning, with special reference to the use of experimentation, observation, discussion, and reading experiences in the elementary science program.

4. Each program was to be planned around a problem or topic in science and present various kinds of motivational and instructional materials or simple equipment teachers might use in stimulating further experiences in science between each telecast.

5. Programs would emphasize certain science concepts related to chosen science areas and their inductive development through problem-solving experiences which can be carried on by children.

6. The programs would not be designed for the direct teaching of science content as such but would be suggestive or openended to allow teachers opportunity to plan further experiences as individual needs and general interests of the children indicated.

7. Supplementary materials on the utilization of the televised experience were to be provided in the form of a manual which defined purposes of each telecast for the teacher and children; ways of developing a readiness for the televised lesson; and suggestions of other learning experiences which might be planned and carried on between telecasts.

8. Teachers participating were to accept the televised materials as a basis for planning experiences in science; to agree as far as possible to make use of the total series of ten programs; and make provision for single-group viewing in their own classroom.

9. Assessment of the value of each program to pupils and teachers in encouraging further work in science was an evaluation of each program. This was to include reaction to the program content and methods of presentation; their contribution toward science teaching; and the kinds of learning experiences carried on. These evaluations were to be used in comparing as an aid in increasing the usefulness of succeeding programs.

10. Other evaluation procedures and devices to be used in assessing the effectiveness of the science telecasts were to include:

    a. Teacher attitude questionnaire, devised by investigators to measure the attitudes and relative feelings of confidence of teachers toward carrying on four kinds of learning experiences. This was to be taken before and after the completion of the televised series and statistically analyzed as one index of the relative effectiveness of the televised science series toward teacher understanding in science.

    b. Standardized pupil tests in science to be given to fourth grade children before and after the completion of the telecasts to measure their effects in contributing to the development of certain problem-solving abilities.

    c. Check-list of behaviors in science to be used by teachers in evaluating certain identifiable attitudes, to be checked at the mid-point of the televised series and again at the end as indices of any noticeable changes in the children.

d. A final evaluation to which teachers were to react in summarizing the over-all value of the telecasts in improving their science teaching.

e. Statements from principals and supervisory personnel on the in-service value of the two-purpose approach used in the study.

f. Interviews with teachers selected through random sampling in which personal reactions were to be sought on certain questions about science and the use of television in providing consultant services.

g. Observations in the classroom by members of the research staff to study the kinds of uses made of the televised experience by teachers.

C. SELECTION OF TEACHERS FOR THE STUDY

The decision was reached to invite as participants third- and fourth-grade teachers from both Columbus and the adjoining county schools within reception distance of the University station, WOSU-TV. The decision to include this particular group was based on several factors. The first of these was an existence of other television programs in elementary science that caused other grade levels to be unavailable. The second factor was the desire to have a spread of two grades so that there would be greater likelihood of securing an adequate number of participants. Third, the decision to include county as well as city teachers was based on the desire to test out the value of such programs in different kinds of schools, especially in terms of the availability of materials and consultant services.

The process of selection involved sending a letter through the appropriate administrative channels to all elementary principals in the areas with which the study was concerned. This letter described the study and solicited volunteers among the teachers in the elementary schools of the area. Responses came directly to Mr. Evans as Chief Investigator for the study.

The total number of teachers who began the study as shown in Table 1 was 151 with the majority from the Columbus schools. A total of 4,814 children was represented by the teachers. The number of third grade teachers was 61 out of the 151, 78 taught fourth grades, and 12 taught mixed third-and fourth-grade groups. The total number of children in each of the three kinds of groups is found in the table.

In January, the 151 teachers were invited to attend an orientation session at University School. In the meeting the purposes of the

Table 1

Number of Teachers and Pupils Participating in the Study

	Location			Grade			
	Columbus	County	Total	Third	Fourth	Mixed	Total
Teachers	116	35	151	61	78	12	151
Pupils	3,752	1,062	4,814	1,937	2,471	406	4,814

study were described again. In addition, teachers took the attitudes instrument entitled "How Do I Feel about Teaching Science?" Also, they saw a sample program that had been kineoscoped. (This was the second program in the series, entitled "Magnets.") Teachers received a copy of the teacher's guide that had been prepared to go with this program. Finally, the teachers received a copy of the evaluation instrument which was to be sent in after each of the ten television programs had been used.

Chapter II.
PREPARATION OF EVALUATION MATERIALS AND PROGRAMS

This chapter deals with the preparation of materials needed for evaluation of the programs and also describes the preparation of the programs themselves. The evaluation material is described briefly with reference to the appendix in which the interested reader will find the complete material or samples of it.

A. EVALUATION MATERIALS

Six types of evaluation materials are described in this section. All but one of these were developed for the study by the investigator and his assistants.

The first instrument has already been mentioned. This was an attitudes questionnaire to assess the level of confidence of the participating teachers, "How Do I Feel about Teaching Science," which was given before the project started and again at the close to test their feelings about carrying on certain kinds of learning experiences in elementary science. Eight possible learning situations, taken from the biological or physical sciences, were described. Under each of these situations various kinds of learning activities were listed. About each of these, the teachers were asked to react in terms of a five-point scale as to their feelings of confidence. (See Appendix A.)

Sequential Tests of Educational Progress published by the Cooperative Testing Service of Princeton, New Jersey, were used for fourth-grade children to measure various aspects of thinking and the ability to use science information in situational problems. Tests were not given to third-grade children because of the inability of the staff to find satisfactory testing materials suitable for this grade level.

Individual program evaluations were designed to test the general reaction of teachers to the programs as presented. This form included an 18-point item in which teachers were asked to indicate the general interest and appropriateness of the content and the degree to which the program design contributed to the purposes of the study. They were also asked to describe the kinds of activities which were carried on to give the staff some idea of the degree of involvement and the kinds of experiences which grew out of or developed as a result of the particular program as presented. (See Appendix B for individual evaluation form.)

Teachers were also asked to react to a final evaluation form on the series as a whole. This form included 25 items based on a four-point scale from "very little" to "very valuable." The items covered the contribution of this series toward clarifying the purposes of science teaching; the use of experimentation, observation, reading and discussion as major ways of learning elementary science; and the general use of the television program toward inviting some kind of consultant service. An open-ended question was also included at the end of the evaluation form, in which they were asked to comment briefly on any other aspects of the program which were not provided in the specific items of the evaluation form.

Principals and supervisors were also asked to express general reactions to the contribution of the series to the teachers in terms of the extent to which these had been observed. This was an open form soliciting any kind of response which they wished to make.

Personal interviews were also carried on with 20 teachers picked at random from the total group. It was felt that this type of personalized evaluation would give the staff a further index of the feelings about the contribution of this series, which teachers were asked to discuss in terms of selected questions.

B. THE PROGRAMS THEMSELVES.

Each of the 10 programs was outlined in terms of the point of view already expressed in Chapter I. The emphasis, as has been indicated, was not on direct teaching of children but on stimulating their interests in the field by proposing a variety of ways in which they could find out more about the topic being presented in the telecast. The thumb-nail descriptions of each of the 10 programs which follow will indicate the general organization of the entire series, "How Do We Find Out?"

Program I: How Do We Find Out?

The first program was conceived, in general, as a means of orienting the pupils and their teachers to the television classroom and establishing a beginning relationship between the television teacher and the pupils, as well as providing both the teachers and students with a frame of reference for the subsequent programs.

The more specific purpose of the program was to explore possible guides to learning; ways of initiating science experiences; ways of developing a classroom environment which would provoke thought and challenge children's curiosity; and the use of experimentation, observation, construction, and reading as the means by which information could be found and questions answered.

Program II: The Mysterious Magnet

Although all of the lessons in the "How Do We Find Out?" series continually emphasized thinking and problem-solving, Program II was particularly designed to point out this concept in the teaching of science. It was constructed to show some ways of encouraging constructive thinking in problem-solving situations in the area of magnetism. Attention was drawn to the need for withholding judgment and the danger of drawing conclusions from limited information.

The children were given suggestions as to possible areas they might like to explore; shown ways of experimenting with magnets; encouraged to develop a list of questions about magnetism; and advised on setting up a research center with materials which they might locate and bring to school. In addition they were asked to review the ways of "finding out" and the steps used in performing and recording experiments.

Program III: Working with Electricity

Emphasis on the essential value of first-hand experiences and the use of a variety of activities was the principal theme of this lesson. Reading from a variety of sources was stressed as a means of securing additional information.

Activities involving experimentation, observation, and construction were presented in such a way as to provide for the maximum amount of student participation in the science periods to follow the telecast.

Furthermore, the lesson attempted to break down some of the fears that might have existed in regard to experimenting with electricity. At the same time, each experiment stressed the need for proper handling of electrical equipment. The program concluded with a brief discussion of safety measures.

Program IV: Our Planet, the Earth

The fourth program of the series emphasized the necessity for good planning, employing such procedures as deciding on the approach; identifying problems to be solved or hypotheses to be tested; organizing for study; and evaluating and utilizing results, as a useful framework for adapting all classroom situations into useful learning experiences.

Children were encouraged to re-examine their ideas about our earth, its features, and position in space. Ways were shown of using common materials to help children visualize certain motion relationships for an understanding of day and night and seasonal changes.

Program V: The Moon and Stars

This lesson continued the rudimentary study of astronomical relationships as an area of elementary science teaching. Stress was given to the importance of evaluation in effective study and teaching, this program being the half-way point in the series.

The major emphasis was on the use of some important event taking place in the environment to foster learning, in this case, the impending eclipse of the moon a few days after this telecast. The lesson further demonstrated the use of simple materials and activities in learning more about the earth's nearby and faraway neighbors in space. Some basic principles of rocket motion were examined.

Program VI: Air Works for Us

The emphasis of this lesson was to encourage the development of possible procedures to test and observe results as they work with materials and forces related to the study of air. The telecast capitalized on the failure of a demonstration of the previous lesson to raise the question of what is done when an experiment or demonstration does not seem to work as it should; and how it might be used as a learning experience to develop certain guide lines to insure greater success when the children are planning and doing experiments.

The appearance of a guest on the telecast emphasized the use of community resources.

Program VII: Today's Weather

In this, the first of two programs dealing with weather, the importance of careful observation coupled with accurate methods of keeping records was highlighted. Instruction in ways of constructing simple weather instruments to help observe changes in the weather was also a significant part of this lesson.

The children were shown the relationship of weather information to various occupations and a partially completed chart of the water cycle added emphasis to the discussion of the importance of weather conditions to everyone.

Program VIII: More About Today's Weather

Most children seem to be prone to excessive dependence upon the use of authorities in shaping ideas, concepts, values, and beliefs, but little on their own discoveries. In helping children develop a sound interpretation of the environment, there is sometimes a tendency to give excessive guidance by using certain leading questions or by "telling."

The underlying purpose of this lesson was, first, to discourage this excessive allegiance to authority; second, to encourage a method of inquiry; third, to point out that to predict results and control events, we must determine the conditions that are necessary and sufficient for the events to occur; fourth, to foster the development of the inquiry of children into levels of abstract and generalized thinking by encouraging them constantly to seek "cause and effect" relationships.

This was tested out by presenting a demonstration of how snow clouds are formed. No oral description or discussion was carried on. Suggestions were provided as to how to use the experience in encouraging children to do their own thinking and coming to some decision on the basis of observations made.

Program IX: Rocks Changing to Soil

The significance of first-hand experiences with materials in the classroom has been continually reiterated throughout the series. However, the materials of science are also found outside the classroom. Certain areas and concepts of science can take on greater meaning if children can see evidences of their effect on the environment. Field experiences can be invaluable teaching aids when they are cooperatively planned and purposes are clearly identified and understood by the children, when they are up with experiences to clarify observations made in the field.

This lesson points out the significance of these aspects of field experiences to both teachers and children, while seeking to arouse interest in this way of learning about science through taking the group to a place where erosion and weathering agents can be seen operating to change rocks to soil.

Program X: Big and Small Plants

The final television lesson in the "How Do We Find Out?" series was designed to serve as a concentrated review of the ways of finding out which had been emphasized throughout the 10 lessons using the study of plants as a basis for this review. By demonstrating the use of experimenting, constructing, observing and recording, and reading in conjunction with a specific subject area, the danger of pedantry was skirted. The teachers were indirectly reminded of the use of various aids to teaching, while the children were given specific directions for activities which they might carry on even after the close of the school year.

Participating teachers received, before each telecast, a guide to its use. This guide generally opened with some information about science teaching with particular reference to the program under discussion and some suggestive pre-telecast questions for teachers with things to look for and major concepts touched upon in the program. Also, there was a section entitled, "After the Telecast: Some Suggestive Leads to Learning," which was followed by additional questions to be raised and related activities. A bibliography was included at the end of each teacher guide.

Chapter III.
REPORT OF THE RESULTS OF THE STUDY

As indicated previously, several types of evaluation instruments were devised for use in gathering information from which assessments could be made of the over-all effectiveness of the television programs designed to serve the dual purpose of stimulating greater pupil interest in science and encouraging teachers toward better science teaching. Such information, both subjective and objective in nature, came from teachers and pupils; the principals in the schools using the series; supervisors and other administrative personnel concerned with the instructional programs of their schools; and members of the research staff. This chapter reports the data gathered and interprets these from inferences provided through the use of certain statistical procedures.

In the treatment of the kinds of samplings made responses obtained, one is always concerned with whether differences are significant. Third- and fourth-grade teachers were asked to make subjective judgments by ranking items on the evaluation froms in terms of a certain point scale. Because they responded in varying numbers, not only to the items within each evaluation instrument but to all the instruments used, it was necessary to use nonparametric techniques of hypothesis testing in analyzing the raw data, with chi-square statistics applied to determine within the probabilities of chance, the relative degree of significance of the observed differences in the samples. The methods of treating the samples and statistical procedures used are appropriately indicated.

A. EVALUATION OF EACH TELECAST

One evaluation instrument (see Appendix A) was used to obtain two types of information about each program: (1) general reaction to the program in terms of interest, pacing, and the like and evaluation of its effectiveness toward contributing to the interpretation of certain phases of elementary science teaching and (2) report of the kinds of activities carried on following each telecast. As previously indicated, the programs were not concerned with total teaching of science content but emphasized ways of learning science.

Table 2 summarizes the responses of teachers to the various items found in the first part of the evaluation form for each program, based on the total 1,073 responses. Teachers responded in varying numbers to each of the 10 bi-weekly evaluations, both to individual items in the evaluation instruments and in the total number of evaluations returned. Return of responses ranged from 133 returned on the second program to 89 on the last telecast, with an average of 107 evaluations returned for the 10 programs.

The responses for the various items were based on various kinds of

Table 2

Summary Evaluation of Ten Telecasts
(Total evaluations returned: 1073)

Items on evaluation form	Frequency	Per cent
1. General level of interest to telecast as a whole?		
a. Excellent	380	35.7
b. Good	556	52.4
c. Fair	115	10.8
d. Poor	12	1.1
Total	1,063	100.0
2. Degrees of interest level during program?		
a. Sustained throughout	667	67.6
b. As program progressed	131	13.4
c. Less as program progressed	185	18.7
d. At no time	3	.3
Total	986	100.0
3. General interest level higher with:		
a. Boys than girls	229	21.7
b. About even	791	74.8
c. Girls than boys	37	3.5
Total	1,057	100.0
4. Pace of program?		
a. Too fast	146	13.8
b. About right	886	83.7
c. Too slow	27	2.5
Total	1,059	100.0
5. Activities or experiences presented invoking greatest interest?		
a. Experimental	795	57.2
b. Observational	385	27.7
c. Reading	59	4.2
d. Discussion	151	10.9
Total	1,390	100.0
6. Appropriateness of content to maturity of children?		
a. Very well chosen	238	22.6
b. Satisfactory	689	65.6
c. Above	106	10.1
d. Below	18	1.7
Total	1,051	100.0

Table 2 (continued)

	Frequency	Per cent
7. Effectiveness of experiences in contributing to concept development?		
a. Excellent	227	21.8
b. Good	678	65.2
c. Fair	129	12.4
d. Poor	6	.6
Total	1,040	100.0
8. Vocabulary level for children?		
a. Above	96	9.1
b. About right	957	90.2
c. Below	7	.7
Total	1,060	100.0
9. Effectiveness of telecast in encouraging further discussion, planning and exploration in science (children)?		
a. Excellent	346	32.7
b. Good	538	50.8
c. Fair	159	15.2
d. Poor	14	1.3
Total	1,057	100.0
10. Organization of program through question and partial answer -- Is enough given so you can continue?		
a. Excellent	248	23.4
b. Good	668	63.0
c. Fair	138	13.0
d. Poor	4	.6
Total	1,058	100.0
11. Effectiveness of telecast in giving ideas and leads to follow-up in teaching science (teacher)?		
a. Excellent	353	33.2
b. Good	613	57.6
c. Fair	97	9.1
d. Poor	1	.1
Total	1,064	100.0
12. Range and variety of experiences on telecast to meet individual differences?		
a. Excellent	168	15.9
b. Good	732	69.3
c. Fair	154	14.6
d. Poor	2	.2
Total	1,056	100.0

Table 2 (continued)

	Frequency	Per cent
13. Number of ideas or problems explored on telecast were:		
a. Excessive	188	18.8
b. About right	799	79.7
c. Too few	15	1.5
Total	1,002	100.0
14. Rapport of television teacher with children?		
a. Excellent	342	34.2
b. Good	581	58.0
c. Fair	74	7.4
d. Poor	4	.4
Total	1,001	100.0
15. Effectiveness of pre-telecast questions?		
a. Excellent	197	20.3
b. Good	627	64.4
c. Fair	144	14.8
d. Poor	5	.5
Total	973	100.0
16. Usefulness of suggestions to teacher in manual?		
a. Excellent	419	42.6
b. Good	509	51.7
c. Fair	56	5.7
d. Poor	0	0
Total	984	100.0
17. Value of suggested activities for children in manual?		
a. Excellent	342	34.7
b. Good	555	56.2
c. Fair	89	9.0
d. Poor	1	.1
Total	987	100.0
18. Quality of television production -- in visualizing materials?		
a. Excellent	245	25.1
b. Good	614	62.8
c. Fair	108	11.0
d. Poor	11	1.1
Total	978	100.0

scales, which necessitates the use of a second table (Table 3) for meaningful interpretation. Also, several items were so keyed for response that median figures are inappropriate and separate treatment of the responses for these items is given below.

Evaluation of general effectiveness. The major value of the regular evaluation of each telecast came in what was revealed each time about the specific telecast. Since telecasts were prepared several weeks in advance, the feedback of information about the success of a given program could not usually affect the immediately succeeding program but could make a difference in planning those not as yet taped.

Looking at the responses for all 10 telecasts, one may find some data for general evaluation of the series and especially for comparison of how the responding teachers felt about differences among the 10 telecasts. On the 11 items that were scaled for four-place response as shown in Table 2, it is apparent that some programs ranked more highly than others. All except one are shown from median total rankings (medians among the 11 items) as rating at or about three points. The exception, program 8, with its ranking of 2.9, may be explained in part as a result of audio failure in transmission during part of its presentation.

In terms of the 11 items, the highest median rating (3.3) goes to item 9, the usefulness of the program manual in terms of its suggestions for teachers. Other top items (3.2) are general interest (item 1), rapport of television teacher with children in the classroom (item 7), and usefulness of the manual, this time in terms of pupil activities (item 9). All these aspects of the programs were highly valued, of course; the degree of success with which they were thought by teachers to be realized is of great interest to the planners of the series. The presence of two items dealing with the value of the program manual may need to be thought through for what it indicates about the extent to which teachers accepted the basic idea of the telecast series, which was to encourage the more effective teaching of science.

A look at the four items ranking lowest (all 3.0) may also be of interest. Here there are item 2, general contribution to concept development; item 4, effectiveness in being open-ended; item 6, meeting individual differences through range and variety of experiences; and item 8, effectiveness of pre-telecast questions.

The first of these is not surprising since the series is expressly directed at pupils in terms chiefly of stimulating interest. In fact, every effort was made to keep from moving into direct teaching as such. The comparatively low rating of the success of the programs in being open-ended is disappointing since this was a major element in their design. The hope was that teachers would find the programs highly effective in stimulating pupil activity. Similarly, it would have been rewarding to have found higher ratings for the programs' success in

Table 3

Ratings of Ten Telecasts on Eleven Four-Place Items

Items	Program Number										Average median response
	How Do We Find Out? 1	The Mysterious Magnet 2	Working with Electricity 3	Our Planet-The Earth 4	The Moon and Stars 5	Air Works for Us 6	Today's Weather 7	More About Weather 8	Rocks Changing to Soil 9	Small and Big Plants 10	
1. General level of interest (Item #1 on original evaluation form)	3.2	3.4	3.1	3.1	3.1	3.2	3.0	2.9	3.7	3.1	3.2
2. Contribution to concept development (#7)	3.1	3.3	3.0	2.9	3.0	3.1	2.9	2.9	3.2	3.0	3.0
3. Encouragement of further activity (discussion, planning, exploration (#9)	3.3	3.4	3.1	3.2	3.1	3.0	2.9	2.8	3.4	3.0	3.1
4. Effectiveness in being open-ended (#10)	3.1	3.3	3.1	3.0	3.0	3.0	2.9	2.9	3.2	3.1	3.0
5. Effectiveness in giving teacher ideas for follow-up (#11)	3.2	3.2	3.2	3.1	3.2	3.0	3.0	2.9	3.1	3.2	3.1
6. Meeting individual differences through range and variety of experiences (#12)	3.1	3.1	2.9	2.9	2.9	3.0	2.9	2.9	3.0	3.0	3.0
7. "Rapport" of television teacher with children in classroom (#14)	3.2	3.3	3.2	3.1	3.1	3.3	3.1	3.0	3.0	3.2	3.2
8. Effectiveness of pre-telecast questions (#15)	2.9	3.0	3.0	3.0	3.0	3.2	2.9	3.0	3.1	3.1	3.0
9. Usefulness of manual for program: suggestions to teachers (#16)	3.3	3.3	3.0	3.3	3.0	3.5	3.3	3.2	3.4	3.4	3.3
10.Usefulness of manual: pupil activities (#17)	3.2	3.2	3.2	3.2	3.2	3.3	3.1	3.1	3.3	3.3	3.2
11.Quality of television production in visualizing materials (#18)	3.0	3.1	3.1	2.9	3.1	3.3	3.0	2.9	3.3	3.1	3.1
Median among 11 items	3.2	3.3	3.1	3.1	3.1	3.2	3.0	2.9	3.2	3.1	3.1

suggesting a range and variety of experiences that might help provide for individual differences. The lower rating on effectiveness of pre-telecast questions is perplexing to some extent, considering the high ratings given to other aspects of the materials provided to help teachers utilize the programs.

Turning now to the other items of the regular individual evaluation forms for the telecasts, the data shown in Table 2 for the items not suitable for four-point rating can be examined quickly. In item 2, the total series is rated high for its success in sustaining interest throughout each program (67.6 per cent.) In item 3 it is noted that the interest level was rated somewhat higher for boys than for girls, but the bulk of responses (74.8 per cent) thought it about even.

Item 4, pace, was judged to be about right in nearly 84 per cent of the responses. On item 5, activities or experiences presented invoking greatest interest, those of an experimental nature were ranked highest (57.2 per cent), as would have been hoped. On appropriateness of content to maturity level, 65.6 per cent of the responses judged the programs satisfactory. In item 8, the programs were rated very high (90.2 per cent) in terms of the level of vocabulary. Finally, item 13, in judgment of the number of ideas or problems explored on the telecast, the "about right" responses totaled 97.7 per cent.

It may be worth noting that on these items, when there was opportunity to respond to whether the programs aimed above or below the maturity level of children, although the bulk of responses were at the "about right" position, the others were more in the direction of the programs being above rather than below. This problem of overloading or gearing too high remains one of continued concern for producers of such telecasts.

In summary, the evaluations made by teachers of each program were found valuable in planning for programs not as yet produced and may give some data for making judgments about the total effectiveness of the series. Perhaps the most striking result of looking at the program evaluation in this way is to find the high value placed by teachers on the manuals that accompanied the series.

Data on follow-up activities. The second part of the evaluation form for each telecast was concerned with the kinds of teacher-pupil involvement occurring after the program. Teachers were asked to describe briefly any significant follow-up learning experiences. According to reports, the degree of teacher-pupil involvement after each program differed for a variety of reasons -- the previous science experiences of the children with a given topic; occasional absence of the teacher; other school activities which took time from the instruction program; and the general feeling of confidence toward trying out some of the activities in relation to certain science areas. Also, teachers were sometimes still working on the content of a previous program and felt it was more important to continue this than drop it when interest was high. Since this situation was mentioned several times, it raises a question about the best time interval between such telecasts.

Because of this question, two companion programs were presented on the earth and its relationship to the solar system (4 and 5) and on weather (7 and 8).

Another problem reported by teachers was the need to understand a new use of television--for instructional purposes. Children may see television as a medium for entertainment where little actual involvement is expected. As the programs progressed, children began to broaden their viewpoint through seeing the need to pay closer attention. The kinds of involvement provided in the programs themselves and the kinds of interaction resulting from what was seen on each telecast, along with what the teachers did toward helping children further interpret the many ideas in the experience, contributed to the development of new attitudes and responses to television as an instructional medium.

It is impossible to list all the comments recorded by teachers. However, the extent to which many went in describing all the activities carried on indicates the depth and scope of follow-up experiences. These comments showed the programs did provide an operational definition of science and ways of learning science which could be adapted to a given teaching situation. Teachers' reports went into detail on the teaching processes used; that is, on how it was done rather than what was done.

B. FINAL EVALUATION OF SERIES AS A WHOLE

After the completion of the 10 televised science lessons, teachers were asked to respond to a questionnaire to assess the value of the use of television in providing a consultant service by indicating the relative value of the series as a whole toward increasing their understanding of elementary science teaching.

Table 4 shows the statements to which they were asked to respond with the frequency and per cent of response given to a four-point scale of Very Valuable, Valuable, Some Value, and Very Little Value. The measure of central tendency is expressed in terms of the classification having the greatest frequency and is identified as the modal category in the table. An opportunity was also given at the end of the questionnaire for general remarks, which will be summarized as a second part of this section.

A total of 115 third- and fourth-grade teachers responded to the instruments, with most of them from the city school system inasmuch as the surrounding county schools were completing their school term shortly after the last program was presented.

Table 4

Final Evaluation of Ten Telecasts in Terms of Their Contribution to Certain Phases of Elementary Science Teaching

1. To what extent has the series, "How Do We Find Out?" contributed to your teaching of elementary science through acquainting you with:	Frequency and per cent of response (Very valuable to very little value)								Modal category
	VV	%	V	%	SV	%	VLV	%	
a. various approaches or leads to science teaching useful in planning with and for children?	44	38.2	61	53.1	10	8.7	0	0	V
b. ways teachers can broaden their backgrounds of science through planning and working along with children?	48	41.7	55	47.8	12	10.4	0	0	V
c. need for using a variety of teaching materials and resources to make science learnings meaningful?	53	46.1	50	43.5	10	8.7	2	1.7	VV
d. possibilities for relating other skill and content areas and science?	22	19.1	59	51.3	31	26.9	3	2.6	V
e. ideas for a classroom environment to encourage pupil interest and motivation for learning?	50	43.5	53	46.1	10	8.7	2	1.7	V
f. examples of ways of solving problems to encourage children's questioning, thinking, and testing of ideas before drawing conclusions?	33	28.7	65	56.5	15	13.0	2	1.7	V

Table 4 (continued)

2. The series has emphasized experimenting, observing, recording, constructing, and reading as major ways of learning science. How valuable has this emphasis been to your teaching through:	Frequency and per cent of response (Very valuable to very little value)								Modal Category
	VV	%	V	%	SV	%	VLV	%	
a. suggesting ways of using simple, easily obtained science equipment for classroom experimentation?	52	45.2	51	44.4	10	8.7	2	1.7	VV
b. acquiring additional science equipment by the school?	15	13.0	26	23.6	42	36.6	32	27.8	SV
c. encouraging more reading in a wider variety of science books as a way of finding out?	35	30.4	50	43.5	26	22.6	4	3.5	V
d. the use of science materials in and out of school which encouraged careful observation as a way of finding out?	33	28.7	55	47.9	24	20.8	3	2.6	V
e. showing ways of keeping different kinds of records of observations as means of gathering information?	37	32.2	58	50.4	16	13.9	4	3.5	V
f. presenting ways of designing and constructing simple science materials which help to visualize science concepts?	40	34.8	53	46.0	17	14.7	5	4.3	V
g. encouraging children to experiment at home to discover and learn for themselves?	38	33.0	47	40.8	24	20.8	6	5.2	V
h. Furthering children's interest in bringing in things and reporting out-of-school experiences?	45	39.1	49	42.6	19	16.5	2	1.7	V
i. developing parental interest and cooperation toward working with their children in science?	16	13.9	34	29.6	46	40.0	19	16.5	SV
j. using other types of audio-visual aids and community resources in and out of the classroom?	21	18.3	51	44.4	37	32.2	6	5.2	V

Table 4 (continued)

3. To what extent has the televised science lessons contributed to your teaching of elementary science through developing an increasing awareness of:	Frequency and per cent of response (Very valuable to very little value)								Modal category
	VV	%	SV	%	SV	%	VLV	%	
a. some of the developmental characteristics of children and their use in planning science experiences?	24	20.8	59	51.3	25	21.7	7	6.1	V
b. the value of well-defined purposes along with a knowledge of important concepts to give continuity of learning in science?	33	28.7	64	55.6	16	13.9	2	1.7	V
c. the breadth and range of science possibilities which can be found and developed within a given content area of science?	44	38.2	59	51.3	10	8.7	2	1.7	V
d. the importance of teacher enthusiasm and interest to the over-all success of a science program ?	55	47.8	49	42.6	9	7.8	2	1.7	VV
e. the importance of teacher-pupil planning in encouraging, maintaining, and extending the interests of children in science?	49	46.2	57	49.5	7	6.1	2	1.7	V

Table 4 (continued)

4. As the result of your participation in this study, can televised science lessons be designed and produced which:	Frequency and per cent of response (Very valuable to very little value) VV	%	V	%	SV	%	VLV	%	Modal category
a. motivate teachers toward better science teaching through seeing some specific ways to improve?	66	53.9	47	40.8	4	3.5	2	1.7	VV
b. explore the purposes and materials for teaching in ways adaptable to the individual needs of teachers?	50	43.5	58	50.4	5	4.3	2	1.7	V
c. when presented during class time are of value to both teachers and children?	56	48.6	52	45.2	5	4.3	2	1.7	VV
d. if applied to other areas of the curriculum could provide additional consultant services to teachers?	49	42.6	58	50.4	6	5.2	2	1.7	V

* Number of teachers responding = 115

No attempt was made to separate third- and fourth-grade teachers in compiling these data; the study was concerned with a range-of-grades approach to the dual use of television in providing consultant service to teachers and fostering the science learning of children.

Evaluation in terms of specific questions. Many of these items may seem repetitive when compared to those on the evaluation form for each telecast. It was felt, however, that the use of similar items when applied to the series as a whole might reveal new aspects as compared to the serial evaluation of the programs as they appeared. It would seem important to note the frequencies of response in categories adjacent to the modal category when assessing the relative value of the televised series with respect to a particular item.

Referring now specifically to Table 4, it is apparent that for most of the items the teachers responding felt that the program series had been "valuable." Of the 25 items, only two fell below this rating in terms of mode. On five items, the mode was "very valuable."

In examining the responses under each of the four statements, it is possible to gain a clearer sense of the ways in which the series was found to be most valuable. Under statement 1 are six sub-queries that have to do generally with broad aspects of science teaching. The one item (1c) on which the expression was strongest had to do with the "need for using a variety of teaching materials and resources to make science learning meaningful." On this item, 46.1 per cent of the responses were in the "very valuable" category.

Under statement 2 are 10 sub-queries having to do mostly with ways of learning science. Here are found the two items on which the modal response came at the "some value" level. Item 2b, "acquiring additional science equipment by the school," was one; it may well be that the program series made this need more strongly felt and by its nature was unable to assist in fulfilling the need. Item 2i, "developing parental interest and cooperation toward working with their children in science," may be another task on which the programs were felt incapable of providing much help.

The one item in this list of 10 sub-queries which rated "very valuable" has to do with equipment, as did item 2b, but reads "suggesting ways of using simple easily obtained science equipment for classroom experimentation." This was one of the intentions certainly of the programs as planned, since the planners were aware that many of the teachers in the project were not well supplied with equipment and materials for the teaching of science. Also, the planners were concerned with helping teachers make use of simple materials and equipment that could be found in the environment or constructed by pupils.

The modal category for the rest of the items in this section was "valuable." These items covered some of the major ideas behind the telecasts as far as trying to help teachers see how children learn science. For example, item 2b, "the use of science materials in and out of school which encouraged careful observation as a way of finding out," and item 2f, "presenting ways of designing and constructing simple science materials which help to visualize science concepts," both were central to the design of the programs. Thus, the rating of these as "very valuable" or "valuable" by 86.6 per cent (for 2b) and 80.8 per cent (for 2f) are felt to indicate that teachers understood and valued the purposes of the telecasts.

Under statement 3 are five statements broadly defining the base of good teaching in science as in any other aspect of the program as resting on a knowledge of developmental characteristics of children and the like. For four of these sub-queries, the mode is "valuable"; for one, 3b, "the importance of teacher enthusiasm and interest to the over-all success of a science program," the modal category is "very valuable."

Finally, under statement 4 are found four items that are intended to provide for a direct evaluation of the type of approach used in the telecast series. These may be taken separately for consideration since they are keys to the design of the experiment. Item 4a, "motivate teachers toward better science teaching through seeing some specific ways to improve," was one of the five items in the questionnaire where the mode was "very valuable." Actually 53.9 per cent of the responses came in that category, with 40.8 per cent checking the "valuable" position. Apparently the major purpose of the study was understood and highly valued by mostteachers responding to the questionnaire.

Item 4b, "explore the purposes and materials for teaching in ways adaptable to the individual needs of teachers," was marked as valuable by 50.4 per cent of the respondents and "very valuable" by 43.5 per cent. Again, the intent of the program was to be suggestive of many approaches to learning in a given topical area of science and not to prescibe the content for a unit.

In item 4c, "when presented during class time are of value to both teachers and children," the questionnaire presented another major idea behind the study. That this was understood and valued by teachers is indicated through a 48.6 per cent response to the "very valuable" category, with an additional 45.2 per cent marking the series in this regard as "valuable." This is another of the five items in which the "very valuable" category is modal.

The last sub-query, item 4d, "if applied to other areas of the curriculum could provide additional consultant services to teachers," contains another of the major ideas being tested by the study. Here the modal response was "valuable" (50.4 per cent), with an additional 42.6 per cent rating the idea as "very valuable."

Altogether, the responses of the 115 teachers who did return this questionnaire at the close of the series revealed a high degree of acceptance of the purposes of the series and appreciation for the contribution to their teaching that had been made by the programs.

Comments accompanying questionnaire. Many teachers added comments on the series in the space provided for such free responses. While it is difficult to summarize these in such a way as to indicate the spread of the ideas revealed by them, it is thought that the following summary may serve to indicate the major concerns and problems reported by teachers and thus may add something of value to the more formal framework of the final evaluation.

1. Teachers appreciated having an opportunity to participate in the study; felt it was a profitable use of time; and did gain more professional insight toward science teaching and the learning opportunities for children.

2. The open-ended exploratory approach of a selected science area as presented in each telecast was well accepted. The definition given to multiple ways of learning science and the emphasis on the varied directions a science study might take was valued. Teachers accepted and valued the idea that a televised science program could encourage them to be flexible in adapting materials to the interests and abilities of individual groups of children.

3. The programs stimulated the interests of the slow learner as well as the more able pupils. The program stimulated pupil thinking and use of warious ways of finding out; contributed to the development of skills; and encouraged a more questioning attitude about the environment around them.

4. Single-classroom viewing of the television program was preferred for better utilization of the televised experience, expecially in terms of teacher-pupil participation. Large viewing groups were seen as disturbing; viewing was difficult in them; and movement to other rooms impeded the continuity essential to good use of pre-telecast questions in discussion and planning following the telecast.

5. Programs were seen as varying in degree of interest because of previous study of science content of a particular program. Also, the series should have been started earlier according to many respondents, to have avoided conflict with end-of-school activities.

6. Programs can pace teachers and pupils to the extent they feel overly hurried to complete work before the next telecast. In terms of the suggestions for learning given on a program and the amount of time a teacher can give to science, there should be a longer time interval between telecasts if effective follow-up activities are to be expected, many teachers indicated. Teachers appreciated having more than one telecast related to the same area of science.

7. Many third-grade teachers indicated they would prefer 15- or 20-minute telecasts, with more time remaining in the science "lesson" period for children and teachers to interpret the construction and use of materials related to the various learning activities presented by the program.

8. Teachers who may be forced to participate in a study are not constructively responsive or critical in assessing the relative merits of such an experience.

9. Too many learning suggestions in a manual can be as frustrating to teachers as insufficient directions on fewer specific activities, it was indicated; yet the teachers greatly appreciated the range and variety of suggestions given and saw the materials as of excellent value in planning future science activities.

10. Decisions of just what to do in the way of follow-up experiences were sometimes difficult to make because of the varied interests developed through the programs and the time available for science.

11. Time is an increasingly critical factor in the daily program of teachers, a fact which needs to be recognized in the design and evaluation of research studies.

12. Teachers reacted differently to the science content of each program. Some felt that the programs would affect the enthusiam for science by the present third-grade children when in the fourth grade. Some teachers reported that the programs did not always directly relate to textbook materials or other curricular guides. Some felt they had to "cover" both the materials of a program and the "book" too.

13. The television teacher played a vital role through his personality in encouraging children to participate during and following the telecast and by his ability to impart information. Teachers reported that the television teacher was often referred to when children were discussing and comparing their experiments with those seen on a telecast.

14. Some teachers felt that if the programs themselves did not generate sufficient interest, they had no responsibility toward furthering concern for the science topic and consequently did little with the materials of certain programs.

The following are some representative statements of teachers toward the televised science series:

> The series of telecasts were very worthwhile. Our group had more follow through on the lesson on electricity by experiments, and the lesson on rocks by collections, and since our community is definitely rural (and the

season being spring) more before lesson preparation on the last lesson by observing and bringing in flowers, both wild and cultivated, from the vicinity.

I felt 20 minutes would have been long enough for the 3rd grade, they got restless. A good bit was covered in these "shows" that was in 4th grade science. I can't help but feel this may take away a little enthusiasm for 4th grade since we pretty thoroughly covered the material.

This has been a very worthwhile experience for the class, but mostly for the teacher. Sometimes I felt these children of third-grade level had too much to grasp on some of the telecasts, but for in-service help to the teacher they were wonderful.

I appreciate the opportunity of being able to be a part of this survey. I benefited more from these telecasts and the manuals than any science course I have taken-- I have participated in other surveys, but this has been a much closer and more personal interest shown than just conducting a survey.

This series would have been excellent as a TV course for teachers.

This science series was very valuable to me and the children in every way. We only regretted that some experiments and explanations of ways to construct were often said or shown too quickly.

I have observed during each telecast that children are most receptive and most interested when the presentation involves experimental or observational items. They love this type of thing.

I don't believe I would ever sign up for the science series again unless the paper work was kept at a minimum. We, as teachers, are very busy people. We cannot be pressured to making out reports. This has been my only criticism.

The topics were well chosen, I feel, however, it might have been better had the programs been 15 minutes each week. We found that there was so very much from which to expand it became difficult knowing which route to take. However, I did find it to be a great help in teaching science and extremely valuable.

I have learned many things of which I never had read or thought of to teach children. The meaning of science has changed. The children were very interested in all phases of science all the way through. I was glad to have this experience and have a wealth of material.

This TV series has shown that the teaching of science doesn't require a ready made kit and a teacher who knows everything there is to know about science. This course of study has now opened science to me as a stimulating area for the children of today.

The programs were quite valuable for enriching the science curriculum. The children were always eager listeners and did rather well in recording their experiments. This program could be of more value if it could follow materials that could be found in our textbooks more. Many subjects covered on TV were not in the 4th-grade science series. We did enjoy it and learned many things.

Some of my better students obviously gained valuable knowledge and interest in science from the programs. I benefited greatly from seeing the programs and in another year if I would be with a different group of children I think I would and could spend more time on science teaching.

I have noticed that even though we have started a new science project, the children are still alert to things they observe and find referring to previous programs. Many of them have brought in interesting things months after the TV program. I feel more time could be spent on each of these specific areas of study. It was a great deal to cover in two weeks time.

The good points are many. I have gained an immeasurable amount of information to further my teaching of science. The children will not be content, either, to have science the last 15 minutes on Friday afternoon. Most of the subjects I checked I could not handle very well, now can be taught reasonably well. I would like to see the program expanded to fields other than science, however, not drop the science.

This has been an excellent teaching device, as far as my own personal opinion is involved. A great deal of interest in science was evidenced by the children throughout the year, as a result of things seen on the telecast; or experiments and observations that naturally followed as a results of "snowballing" interest.

C. CHANGES IN TEACHER ATTITUDES

In trying to assess the existing feelings of confidence of teachers toward certain types of learning activities and any changes occurring after the televised science programs, an attitude questionnaire was constructed, tested, and revised prior to its use with teachers participating in the study being reported. A total of 84 teachers taking science and non-science graduate summer school courses in the Department of Education at The Ohio State University reacted to the various drafts of the questionnaire. It is from the criticisms and suggestions made by these teachers on the first and second drafts, and information gained through applying certain statistical procedures, that the instrument as finally designed was used to identify teacher attitudes toward carrying on certain kinds of learning experiences.

The instrument as finally revised (see Appendix B) is composed of eight science-learning situations, conceived of as representative of possible situations arising in an elementary school classroom. Four of the situations are related to content in the biological science, and four are related to the content and materials associated with the physical sciences.

Under each teaching situation, five learning activities are described, each of which falls into one of these four categories: experimentation, observation, discussion, and reading. A total of 40 items is found under the eight learning situations, with their number being equally divided between the four types of learning activities mentioned above and also between biological science and physical science.

The design of the instrument may be seen in the following summary of activities:

Types of activities	Biological science	Physical science	Total
Experimentation	5	5	10
Observation	5	5	10
Discussion	5	5	10
Reading	5	5	10
Totals	20	20	40

Table 5 reports the frequency of response of participating teachers to each of the five learning activities under the eight learning situations

Table 5

Teacher Responses to "How Do I Feel About Science?" Before and After Telecasts

Activity	Time	Frequency of response (Very confident, uncertain to very unconfident) VC	MC	U	MU	VU	Total Freq. of resp.	Median	Z*	p**
SITUATION A - Biological										
(1) Observation	Before	71	58	14	1	0	144	4.0	2.91	<01
	After	75	34	3	1	0	113	4.5		
(2) Observation	Before	32	65	36	10	2	145	3.3	4.06	<01
	After	48	48	13	1	3	113	3.9		
(3) Experiment	Before	57	64	13	8	2	144	3.7	3.72	<01
	After	66	40	7	0	0	113	4.2		
(4) Discussion	Before	57	73	11	2	1	144	3.8	3.80	<.01
	After	71	40	2	0	0	113	4.2		
(5) Reading	Before	48	52	35	7	3	145	3.5	3.74	<01
	After	59	39	14	1	0	113	4.0		
SITUATION B - Biological										
(6) Experiment	Before	39	58	33	9	6	145	3.4	4.58	<.01
	After	57	40	12	4	0	113	4.0		
(7) Discussion	Before	32	50	44	16	3	145	3.2	3.98	<.01
	After	40	49	24	0	0	113	3.6		
(8) Experiment	Before	20	31	56	28	8	143	2.6	4.55	<.01
	After	24	51	35	3	0	113	3.3		
(9) Discussion	Before-	12	42	49	28	13	144	2.6	4.67	<.01
	After	21	47	38	7	0	113	3.8		
(10) Reading	Before	27	50	37	21	9	144	3.1	4.74	<.01
	After	40	52	14	6	1	113	3.7		

* Z = The standard score computed from Mann-Whitney U Test formula.

**p = Probability of chance error in 1 chance out of 100 or 5 chances out of 100.

Table 5 (continued)

Activity	Time	Frequency of response (Very confident, uncertain to very unconfident)					Total freq. of resp.	Median	Z	p
		VC	MC	U	MU	VU				
SITUATION C - Biological										
(11) Reading	Before	90	42	10	2	1	145	4.2	1.59	N.S.
	After	82	28	3	0	0	113	4.3		
(12) Observation	Before	82	54	5	1	1	143	4.1	3.47	<.01
	After	88	23	2	0	0	113	4.3		
(13) Experiment	Before	62	52	24	6	1	145	3.8	3.70	<.01
	After	88	30	1	0	0	113	4.3		
(14) Reading	Before	47	53	27	12	4	143	3.5	5.12	<.01
	After	71	30	11	1	0	113	4.2		
(15) Discussion	Before	69	47	19	9	0	144	3.9	2.53	<.05
	After	67	40	5	1	0	113	4.1		
SITUATION D - Physical										
(16) Experiment	Before	14	24	48	32	27	145	2.2	6.83	<.01
	After	25	51	28	6	3	113	3.4		
(17) Experiment	Before	17	40	39	33	15	144	2.6	12.60	<<.01
	After	27	64	19	2	1	113	3.5		
(18) Reading	Before	48	58	31	7	0	144	3.5	5.33	<<.01
	After	73	32	7	1	0	113	4.2		
(19) Observation	Before	65	54	23	3	0	145	3.8	4.98	<.01
	After	84	25	4	0	0	113	4.3		
(20) Reading	Before	26	43	49	20	7	145	2.9	6.67	<<.01
	After	43	54	15	1	0	113	3.7		
SITUATION E - Physical										
(21) Observation	Before	31	61	36	11	5	144	3.3	3.31	<.01
	After	48	35	27	3	0	113	3.7		
(22) Reading	Before	36	50	38	13	8	145	3.2	4.10	<.01
	After	49	38	24	2	0	113	3.8		
(23) Discussion	Before	25	41	37	33	4	145	2.7	5.45	<.01
	After	33	58	18	4	0	113	3.6		
(24) Discussion	Before	32	54	42	14	[illegible]	144	3.2	5.02	<.01
	After	51	46	13	3	0	113	3.9		
(25) Discussion	Before	28	34	45	28	10	145	2.7	5.08	<.01
	After	35	52	20	6	0	113	3.6		

Table 5 (continued)

Activity	Time	Frequency of response (Very confident, uncertain to very unconfident)					Total freq. of resp.	Median	z	p
		VC	MC	U	MU	VU				
SITUATION F - Biological										
(26) Discussion	Before	41	62	31	9	1	144	3.5	5.89	<.01
	After	55	49	9	0	0	113	3.9		
(27) Experiment	Before	33	56	39	13	3	144	3.3	4.58	<.01
	After	47	50	16	0	0	113	3.8		
(28) Reading	Before	22	49	52	17	5	145	2.9	4.73	<.01
	After	37	46	29	1	0	113	3.5		
(29) Observation	Before	40	67	31	7	0	145	3.5	3.49	<.01
	After	52	48	13	0	0	113	3.9		
(30) Observation	Before	25	60	46	10	4	145	3.2	4.88	<.01
	After	47	45	18	1	2	113	3.8		
SITUATION G - Physical										
(31) Observation	Before	41	53	28	13	10	145	3.4	3.62	<.01
	After	56	32	20	3	2	113	4.0		
(32) Reading	Before	40	51	37	11	6	145	3.3	4.81	<.01
	After	57	42	12	2	0	113	4.0		
(33) Observation	Before	15	26	52	29	22	144	2.4	5.42	<.01
	After	27	43	26	12	5	113	2.9		
(34) Experiment	Before	38	46	31	14	16	145	3.2	4.75	<.01
	After	54	39	17	2	1	113	3.9		
(35) Discussion	Before	59	59	18	6	2	144	3.7	4.73	<.01
	After	77	32	4	0	0	113	4.3		
SITUATION H - Physical										
(36) Experiment	Before	5	9	33	36	61	144	2.3	6.54	<.01
	After	14	24	42	19	14	113	2.5		
(37) Experiment	Before	13	17	33	46	36	145	2.2	6.50	<.01
	After	29	37	25	15	7	113	3.3		
(38) Observation	Before	8	17	37	42	41	145	1.7	5.97	<.01
	After	23	32	31	15	12	113	2.9		
(39) Reading	Before	23	46	39	23	13	144	2.9	6.16	<.01
	After	51	44	14	4	0	113	3.8		
(40) Discussion	Before	54	60	26	3	1	144	3.7	4.52	<.01
	After	70	39	3	1	0	113	4.2		

before and after the 10 telecasts. These responses were made on a five-point scale of very confident (VC), moderately confident (MC), uncertain (U), moderately unconfident (MU), and very unconfident (MU).

The medians in this table show the relative level of confidence toward each activity, before and after, and are indicative of changes in attitude toward their use as a consequence of the telecasts.

A test of significance was applied to these data to determine the probability of chance error and the levels of significance* of the responses toward each learning activity. As can be seen from the table, the median response to feelings of confidence as related to the various situations in science and/or science teaching went up to the level of significance in which the probability of chance error, with two exceptions, was less than one chance in a hundred.

In interpreting any indicated changes, a median range within each category of confidence was established, to which the tabulated median response for each activity could be related and reported as falling somewhere along the median range for a given category. The following median ranges were used:

Very unconfident = 0.0 - .9
Moderately unconfident = 1.0 - 1.9
Uncertain = 2.0 - 2.9
Moderately confident = 3.0 - 3.9
Very confident = 4.0 - 4.9

Using these median ranges, any changes from one category of confidence to another, as well as those changes within a given category, can be noted. For example, teachers responding to the experiment B-8 indicate their relative feelings of confidence as being uncertain (2.6) prior to the study, yet moderately confident (3.3) following the telecasts.

In every instance, then, the participating teachers are found to have indicated a change toward increased feelings of confidence in carrying on the four types of learning activities as described under each teaching situation.

The differences that existed between the level of confidence teachers felt in terms of biological and physical science activities are reported in Table 6.

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*Mann-Whitney U Test, corrected for ties. See S. Siegel, _Non-Parametric Statistics in the Behavioral Sciences_ (New York: McGraw-Hill Book Co., 1956), pp. 116-127.

Table 6

Median Scores of Teachers Toward Four Types of Learning Activities Before and After Telecasts

Biological Sciences

Activity	Before					Median of medians	After					Median of medians
	Median frequency of responses toward learning activities						Median frequency of responses toward learning activities					
Experiment	3.7	3.4	2.6	3.8	3.3	3.3	4.2	4.0	4.0	4.3	3.8	4.1
Observation	4.0	3.3	4.1	3.5	3.2	3.6	4.5	3.9	4.3	3.9	3.8	4.1
Discussion	3.8	3.2	2.6	3.9	3.5	3.4	4.2	3.6	3.8	4.1	3.9	3.9
Reading	3.5	3.1	4.2	3.5	2.9	3.4	4.0	3.7	4.3	4.2	3.5	3.9

Physical Sciences

Activity	Before					Median of medians	After					Median of medians
Experiment	2.2	2.6	3.2	2.3	2.2	2.5	3.4	3.5	3.9	2.5	3.3	3.3
Observation	3.8	3.3	3.4	2.4	1.7	2.9	4.3	3.7	4.0	3.3	2.9	3.6
Discussion	2.7	3.2	2.7	3.7	3.7	3.2	3.6	3.9	3.6	4.3	4.2	3.9
Reading	3.5	2.9	3.2	3.3	2.9	3.2	4.2	3.7	3.8	4.0	3.8	3.9

The data presented are the medians of the medians of the total responses to the four types of learning activities in the biological and physical sciences before and after the completion of the televised science programs. Inspection shows that prior to the telecasts teachers felt:

1. More confident toward carrying on the four types of learning experiences in the biological science than in the physical sciences. The medians of medians for the four types of activities in biological science range from 3.3 to 3.6, in physical science from 2.5 to 3.2.

2. Least confident toward carrying on science experiments among the four types of activities in both the biological and physical sciences. In biological science, the median of medians for science experiments is 3.3, in physical science 2.5--the lowest for the varied types of activities in both areas.

3. More confident about carrying on observation activities than any of the other types in the biological sciences.

4. Much less confident in the use of observation activities in the physical sciences than in the biological sciences.

5. A little less confident toward carrying on research reading and discussion activities in the physical sciences than in the biological sciences, yet felt about equally confident in the use of these activities with respect to either of the two science fields.

After the science programs teachers felt:

1. More confident toward carrying on all four types of learning activities in both the biological and physical sciences.

2. An equal feeling of confidence toward carrying on discussion and research reading activities in both sciences.

3. More confident toward experimental and observational types of learning activities than discussion and research reading activities in the biological sciences.

In summarizing these results, it is important to note the differences in the medians before and after completion of this series in order to assess the degree of change in feelings of competence.

1. There was a general increase toward feelings of confidence in carrying on all four types of learning activities in both the biological and physical sciences.

2. Significant gains are shown toward the use of experiments in the biological sciences where the degree of confidence as expressed by the median falls in the range as being "moderately confident" (3.3), yet shifted to "very confident" (4.1) after the telecasts, with the amount of shift shown through the difference of the two medians (4.1 -- 3.3). (However, the significance of the difference in the medians was not tested.) Teachers also felt more confident toward carrying on experimental activities in the physical sciences where there was a change from being "uncertain" (2.5) to "moderately confident" (3.3), with the amount of shift shown through the difference of the two medians (3.3 -- 2.5).

3. While teachers felt more confident in encouraging observation type of activities in both the biological and physical sciences, the amount of gain in the physical sciences (3.6 - 2.9) is apparently greater than in the biological sciences (4.1 - 3.6).

4. Teachers also showed increased confidence toward discussion activities, with about equal gains in both the physical and biological sciences.

The medians of response to the various learning activities under a given teaching situation should also be examined to assess the differences in feelings of confidence toward carrying on a specific type of learning activity in relation to a given content area of science. Apparently, not only the particular type of activity but its relation to a given area of science influenced the response of teachers. For example, the discussion activity B-9 shows teachers are "uncertain" (2.6) about the use of the activity described, but expressed a feeling of "moderate confidence" (3.3) after the science programs. An examination of the specific activity described and its relationship to the science content of the teaching situation stated makes it clear why they rated this activity as shown. ("Discuss some other related experiments which attempt to show the same results as the one that failed.")

This is also shown in the response to the activity experiment D-16, where teachers felt "quite uncertain" (2.2) as to the implementation of this activity in the classroom, yet responded as feeling "moderately confident" (3.4) toward the same activity after the completion of the science programs. The activity by its nature involves the construction of simple weather instruments to be used in exploring the science content related to the teaching situation.

A further examination of the various items shows that those involving the use and manipulation of materials and simple science equipment were rated lower than those which did not. This would seem to indicate the need to explore and understand the use of these resources in carrying on certain types of learning activites in science.

Tables 7 and 8 show the level of confidence of the participating teachers toward the four learning situations described in the questionnaire as associated with biological science (Table 7) and with physical science (Table 8) before and after the telecast series. The tables present the number of teacher responses made to each of the five levels of confidence for each learning situation, with the total frequency of response for the situation and the median. Also shown in the total medians for the four learning situations in both sciences.

The Kruskal-Wallis* statistical procedure was applied to the data to determine the probability of chance error and level of significance of the responses toward each teaching situation. As can be seen from the tables, the median response to feelings of confidence as related to the various learning situations in both biological and physical sciences went up to the level of significance in which the probability of chance error was very much less than one chance in a thousand.

An examination of the medians of the responses to the described learning situation before and after the completion of the science telecasts in the biological and physical sciences, shows that the participating teachers apparently:

1. Increased in feelings of confidence toward all the learning situations associated with the biological and physical sciences.

2. Felt less confident toward working with learning situations in the physical sciences (2.9) as compared to the biological sciences (3.5) prior to the science telecasts, yet after their completion showed greater over-all changes and gains in feelings of confidence in the physical sciences (2.9 - 3.7) than in the biological sciences (3.5 - 4.0).

3. Varied in their feelings of confidence toward working with different learning situations in either the biological or physical sciences, with the over-all differences being somewhat greater in the biological sciences, especially before the science telecasts.

The above observations are consistent with the previously reported results. It cannot be assumed of course, that the reported gains are due only to viewing the television programs. The activities initiated through the programs gave many teachers added experience in teaching science and therefore helped affect changes in feelings of confidence. The fact that teachers did try to broaden their experience and derived satisfaction from their own activity in following up the leads to learning provided by the television programs has been previously reported.

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*Ibid., pp. 184-193.

Table 7

Feelings of Confidence of Teachers Toward Biological Science Activities Before and After Telecasts

Learning situation	Frequency of response (Very confident to very unconfident) VC	MC	U	MU	VU	Total frequency of response	Median	
				Before*				
A	265	312	109	28	8	722	3.6	H = 259.29 $p \ll .001$
B	130	231	219	102	39	721	3.0	
C	350	248	85	30	7	720	3.9	
F	161	294	199	56	13	723	3.3	
Total	906	1,085	612	216	67	2,886	3.5	
				After**				
A	319	201	39	3	3	565	4.2	H = 175.09 $p \ll .001$
B	182	239	123	20	1	565	3.7	
C	390	151	22	2	0	565	4.2	
F	238	238	85	2	2	565	3.8	
Total	1,129	829	269	27	6	2,260	4.0	

* Number of teachers responding - 145
**Number of teachers responding - 113

Table 8

Feelings of Confidence of Teachers Toward Physical Science Activities Before and After Telecasts

Learning situation	Frequency of response (Very confident to very unconfident)					Total frequency of response	Median	
	VC	MC	U	MU	VU			
Before*								
D	170	219	190	94	50	723	3.0	H = 135.31 p <<.001
E	152	240	198	99	34	723	3.0	
G	193	235	166	73	56	723	3.2	
H	103	149	168	150	151	721	2.7	
Total	618	843	722	416	291	2,890	2.9	
After**								
D	252	226	73	10	4	565	3.8	H = 57.36 p <<.001
E	216	229	102	18	0	565	3.7	
G	271	188	79	19	8	565	3.9	
H	187	176	115	54	33	565	3.4	
Total	926	819	369	101	45	2,260	3.7	

* Number of teachers responding - 145
** Number of teachers responding - 113

It should also be noted that no direct attempt was made to duplicate any of the specific learning activities described under each of the teaching situations of the attitude questionnaire, although constant reference was made to the use of the four ways of learining in problem-solving situations.

D. GROWTH IN CHILDREN

An essential though more difficult part of the total evaluation of the televised science series is the assessment made of pupil growth in relation to the objectives previously stated. As indicated, the present study was concerned, not only with teacher improvement in science teaching, but also with the value of the televised science programs to pupils in stimulating greater interest and furthering inquiry in science. The total effectiveness of the dual-purpose approach taken must therefore be examined in terms of its contribution toward meeting both purposes. It is the latter which is of concern in this section.

In reporting the findings of this phase of the study and making any kinds of judgments, it is important to keep in mind the conceptual design of the televised programs. The emphasis was on the nature and quality of experiencing in problematic teaching situations and the roles of different kinds of learning activities in providing pupil involvement through which desirable behavior changes and concept development take place. The intention was, therefore, not to teach science content directly but to open up an area of science in such a way as to help children become more familiar with the processes of exploration and discovery which would continue to deepen interest and encourage further scientific inquirey. It was felt that if learning activities essential to the solution of certain problems could be demonstrated and discussed in relation to their utilization in problem-solving situations, this would encourage teachers and children to become more critical of methods and procedures used in synthesizing ideas based on information gained through the learning activities and contribute to the use of scientific habits and attitudes in science.

This evaluation as it relates to pupil growth in science is, therefore, primarily concerned with evidence of continuing pupil interest, changes in problem-solving abilities, and the development of new patterns of behavior in carrying on investigations in science.

Three methods of assessment were used to gain data relative to changes in growth on the part of participating pupils. The first method was an analysis of the comments and responses of the teachers on each of the 10 telecast evaluations. A list of desirable behaviors was also provided all teachers of third- and fourth-grade children at the mid-point of the study with the suggestion that teachers try to evaluate their group in terms of these behaviors at this time and again at the completion of the study. Each of these provided different kinds of evidence as to the relative effectiveness of the total series of 10 science programs in meeting the needs and interests of pupils and the extent to which they encouraged thoughtful scientific inquire. Finally, standardized tests were used with all fourth-grade children, these being administered at the beginning and the end of the study.

Teacher evaluation of pupil interest and growth. As part of the evaluation of each telecast (see Appendix A), teachers were asked to record any impressions of good thinking, problem-solving abilities, and attitudes by describing the nature of the behavior and its significance to the learners. Even though an evaluation of this type is limited by such factors as the length of time of the study, the slowness with which such changes in growth take place, and teacher understanding and awareness of what constitutes desirable problem-solving abilities and attitudes, such subjective evaluations do provide some valuable information as to what teachers considered as important aspects of growth, even though they give no exact statistics on such changes. Examination of these responses showed teachers felt that:

1. Interest varied greatly from program to program, with some invoking little interest and others enough interest to cause teachers to continue the study even though the next program was related to a different science area.

2. Interests varied because of previous studies on some of the topics or science areas explored on a given telecast.

3. Current events and seasons of the year affected the general interest and response of a group toward an area of study.

4. Interests varied in terms of the kinds of learning activities presented on a given telecast, with interest remaining higher after those programs where more experimental activities were presented.

5. Parental interest affected the general pupil interest and desire toward further inquirey, with pupils coming from homes where scientific inquire was encouraged showing that influence on their general interest and depth of inquiry.

6. Interest and further inquire were affected by the methods and completeness of the presentation of activities on a telecast, with more follow-up taking place when they were carried through to completion.

7. Continuing interest was affected by the way teachers followed up the program and the general methods used in planning and organizing for science teaching, with over-structuring a program tending to discourage the inherent values of interest in fostering further inquiry.

A study of individual teacher responses at the end of the fifth and tenth programs for evidences of pupil achievement in problem-solving abilities shows that teachers were becoming increasingly aware of the importance and value of these aspects of pupil growth in evaluating the over-all achievement of children in science. Comments to this item on the evaluation sheet were more frequent as the series progressed. There was an increasing attempt to define and describe specific behavioral changes observed, as compared to the use of more general terms, as is frequently done when abilities and behaviors have not been sufficiently identified so they can be operationally observed in learning situations.

It would also seem that, as teachers became more sensitive to the importance of the development of such behaviors in children and the methods of teaching and learning which promote their development, there was an increased effort to re-examine present approaches to the teaching of elementary science and to try others.

The following are examples of teacher responses to this question on the bi-weekly evaluation sheet returned after the fifth telecast:

> My group this year is an average group and have been rather difficult to motivate. We have our class on Friday. I forgot to remind them to bring in their science materials before they went home on Thursday. I was very happy to see many children bring in science materials the next morning. This is quite an improvement.
>
> I found that in this area of study there was more questioning along this line: "Well, if this is true, what would happen if...?" In other words, they understood that many of these things are not known for sure, but they were constantly asking why scientists think they know. I was very pleased to see their thinking go on beyond the printed page. We had lots of fun reasoning out problems.
>
> The children were very interested in finding causes and searching for facts. They are also developing in reading in other areas--a questioning attitude and checking for other sources of information.
>
> Along with the many things they are learning and have learned, they are also beginning to realize all the things we still have to find out about this world of ours.
>
> The children are beginning to want to know the why for things that happen. At the beginning of the study,

many accepted anything that was said without wanting to know why. The children are beginning to initiate experiments on their own now.

Because this topic, "The Moon and Stars" is one so often discussed and frequently without scientific knowledge, the boys and girls could really use some critical thinking. They have become more questioning of "off-hand reports" and even some written materials.

Always before, interest has died out rapidly after the first week. For the first time, questions were asked about problems of space. Several children could not wait for the class to do the experiments, so they did them at home. They were interested in the pictures and stories. They got many interesting books from the bookmobile without any encouragement from me.

We are learning to question why our experiments do not work. One girl reported she tried the vinegar and soda experiment to form a gas and it did not work. Several children immediately asked, "How much vinegar did you use? How much soda did you use? Was the cork tight?" Children are becoming more observant and are wanting to find the reason why things happen. They question superstitions about things; are increasingly interested in reading; and are assuming more responsibility for bringing materials to school.

The most important attitude this two weeks has been thinking before we answer a question, checking answers we are not positive about, and learning just where we go to find unknown answers.

Children ask many questions and are eager to work together, bringing in different reading materials and want to tell the class about them.

Evidently the ways of finding out shown and discussed in the first program made an impression in the children because they are using more of a variety of ways seeking answers than just through the use of books.

The children still have a tendency to accept statements of others without too much questioning, but they are beginning to see the need of basing ideas on facts and not on the opinions of others. They are seeing the value of using many sources of information. They have a lot of ideas as to why and express them freely and they are learning that answers must be based on more than previous limited information.

When an examination is made of teacher responses to this item after the tenth program, they show even more clearly the kinds of behavior noted in children. The following are examples of their statements:

> Children are more independent in finding answers in reference materials and in suggesting experimental ways of finding answers.
>
> There is a definite change in ability to look for facts and causes before making decisions.
>
> Their reasoning and thinking are improving. They are able to apply what they have learned to new situations to help find the answers to new questions. This is a big improvement.
>
> The children have shown a marked increase in their ability to develop sound conclusions from observations. Even though school is almost over, children's interest in science books has continued.
>
> My class love to talk about things. The children who have difficulty writing, spelling, and reading have experienced a great deal from these programs by having a chance to express themselves orally in our discussions.
>
> The teacher as well as the children has gained a great deal of interest and knowledge toward science.
>
> In this study the children have accepted the finding from experimentation better than at any other time.
>
> The group is much more interested and curious about what is going on around them.
>
> Children are giving more thought to the use of experiments and using their observations to draw conclusions.
>
> Interest was sustained throughout this entire series. Children carried their interests outside the classroom and brought many things to share from their homes or in the community. I have very little measure of their problem-solving ability, but I am sure a very healthy interest has been aroused in all the science areas explored.

> All of the children have shown a great deal of interest in this science series. The children of low and low-average ability have been as interested and attentive as those of higher capabilities.
>
> Children have shown a marked enthusiasm and independence in planning and setting up their science experiments, records, reports, etc., the last few broadcasts.

Observation of children's science behaviors. While these teacher responses gave some indication of changes in pupil behavior, the variety in form and interpretation suggested the need for the behaviors to be defined in operational terms to aid teachers not only in looking for evidence of changes in pupil behavior but also to encourage the further use of observation as an essential part of the total evaluation. It was thought that if certain science behaviors were identified, this would contribute toward furthering individual teacher appraisal of general teaching methods used in fostering science learnings and particularly those procedures which encourage the kinds of pupil-involvement and participation necessary for problem-solving skills and attitudes to become functional.

Fifteen statements were drawn up as descriptions of desirable pupil behaviors in relation to certain problem-solving abilities and scientific attitudes, consistent with the purpose for elementary science teaching and relevant to the purposes of the present study. This list (see Appendix C) was given to the teachers at the mid-point of the study, at which time teachers were asked to use the statements as a kind of checklist to evaluate their group then and again at the completion of the study. A five-point scale was suggested for purposes of determining the relative level of consistency of behavior in relation to each described behavior. No attempt was made to determine the extent of change inasmuch as teachers would evaluate their groups at different points on the scale. The primary concern was the determination of some kind of change as teachers observed individual pupils and their class as a whole working on problems and utilizing the ways of learning science.

Table 9 shows the behaviors identified and the frequency of response of seventy (70) teachers to each statement indicating positive, negative, or no change in behavior. The Sign Test statistic was applied to the data to determine the probabilities of chance error of the positive, negative, and no change responses. As can be seen, all the responses were very significant with the probability of chance to be very much less than one in one thousand. Table 10 is a tabulation of the frequency and the per cent of the responses of teachers within each of several levels of significance. It can be seen that the median level of significance was much less than one chance in a thousand of the responses being in error or having occurred by chance.

Table 9

Results of Teachers' Evaluation of Children's Science Behavior

	Number of Subjects Indicating				
	Positive Change	Negative Change	No Change	Z**	p
(1) Enjoying seaching for answers and showing a natural desire for a logical explanation of things and events occurring around them?	49	3	18	6.16	<<.001
(2) Trying to relate and apply their present information, incorrect as it may be, to logically think through problems, observations, experiments, and other activities carried on?	49	0	21	9.81	<<.001
(3) Using a variety of sources of information?	51	1	18	6.79	<<.001
(4) Questioning and making choices between sources of information?	53	0	17	10.20	<<.001
(5) Seeing the importance of explaning things and making decisions on the basis of fact rather than opinions or unfounded beliefs?	46	1	23	6.42	<<.001
(6) Labeling their sources of information as a basis for authenticity of statements made?	46	2	22	6.79	<<.001
(7) Willing to consider new ideas and change theirs in light of new evidence?	48	2	20	9.00	<<.001

Table 9 (continued)

		Number of Subjects Indicating				
		Positive Change	Negative Change	No Change	Z**	p
(8)	Questioning the statements of others and accepting the questioning of their own statements?	50	0	20	9.80	$\ll .001$
(9)	Seeing the value of working for further evidence before drawing conclusions?	57	3	10	9.68	$\ll .001$
(10)	Showing growth in manipulation and use of science materials in solving problems?	52	2	16	9.44	$\ll .001$
(11)	Becoming more resourceful in suggesting ways of finding out, planning and carrying out an experiment or other designated responsibility?	55	2	13	9.82	$\ll .001$
(12)	Showing an ability to use science information and previous learnings in new situations?	51	2	17	9.43	$\ll .001$
(13)	Seeing the importance of accuracy in experiments, observations, procedures, recordings, etc.	55	1	14	10.01	$\ll .001$
(14)	Reporting things done out of school or at home and bringing them to share with the group?	49	1	20	9.40	$\ll .001$
(15)	Finding parents interested and revealing this interest through reports of how parents have helped them?	43	0	27	9.17	$\ll .001$

* Total = 70

** As computed from the sign test from Siegel

Table 10

Levels of Significant Change in Evaluations of Science Behaviors

Level of significance		Frequency	Per cent
Less than .001		50	71.45
Between .001 and .01		9	12.85
Between .01 and .05		2	2.85
Not significant		9	12.85
	Total	70	100.00

Examination of the various items shows a concern for the kinds of thinking being encouraged, how ideas are being organized into broader concepts through problem-solving experiences, and general growth in scientific attitudes, interests, and appreciations as essential parts of the total science learnings. The last two statements, while not specifically related to the others, do provide some indication of the extent to which school science experiences carried over into the home and other out-of-school activities of pupils, which in turn could effect the in-school science program.

Statements 1, 2, 3, 10, 11, 12, and 13 are related to the development of certain problem-solving skills. The remaining statements, with the exception of the last two as indicated above, define certain attitudes as desirable outcomes of science teaching.

In analyzing and reporting the results of this part of the study, certain limitations are recognized which would prevent sweeping generalizations from being made as to the extent of the contributions of the televised science programs in encouraging the described behaviors in pupils. Such factors seem apparent: the short length of time within which teachers were asked to observe and evaluate any noted changes, the number of teacher responses in comparison to the total number of teachers participating, and absence of any attempt by the research staff to observe or evaluate teaching approaches used by the responding teachers. There is also recognition of the variety of methods and ways of learning which can be effectively used. Each teacher utilizes these differently in terms of purpose, indicated needs and interests of pupils, and his own feelings of confidence toward certain teaching procedures and learning activities. Another factor is the design of each televised program in terms of the extent to which it succeeded in raising questions and stimulating thoughtful inquiry. Also involved is how well teachers used suggested activities to involve children in ways of thinking and learning through which pupil behavior could be assessed.

If these limitations are accepted, the evidence presented would seem to indicate that:

1. Some beginnings of changes in behavior were observed which could be attributed either directly or indirectly to the emphasis placed on them throughout the entire series and a teacher's effort to teach for problem-solving and scientific attitudes in science.

2. Many teachers were aware of the need for problem-solving abilities and attitudes as they relate to thinking through problems and utilized teaching procedures which enabled them to obtain more concrete evidence of possible behavior changes.

3. When science-learning behaviors have been functionally defined in ways which enable teachers to identify them operationally, a more

conscientious effort will be made to evaluate such behaviors as important parts of the total achievement of pupils.

4. Because of the relatively small number of responses to this particular evaluation instrument, teachers either felt such an evaluation was not of major importance or approached the teaching of science in such a way that an evaluation of this type could not be objectively made within the time provided.

5. Teachers, in terms of the length of time, would possibly think in terms of meeting certain needs of pupils and would evaluate in terms of these behaviors to the exclusion of others.

6. Some of the statements as described would possibly need further clarification to enable a teacher objectively to evaluate its presence in the behavior of pupils. This would possibly account for the number indicating no change.

7. Familiarity with the interpretation of an attitude and signs of its presence in the behavior patterns of pupils evidently varied among teachers as shown by the number of teachers indicating no change.

Evaluating pupil growth through the use of standardized tests. Further evidence of changes in pupil achievement in science was obtained through the use of a standardized test intended to be administered before and after the telecasts. This was thought necessary in that the two previous techniques discussed, while valuable in showing that teachers can make increasingly critical subjective evaluations of progress when the desired behaviors have been defined, do not give any exact statistics on pupil growth.

In determining the type of test to be used, consideration was given to the fact that the televised scinece programs were not designed for the total teaching of a prescribed course in science, that both third- and fourth-grade children were participating and that the programs were designed to stimulate further scientific inquiry of children and to encourage the use of the problem-solving approach as a method of teaching science.

An examination of standardized tests in the area of elementary science showed that little was available for use with children below the fourth-grade of a design suitable for purposes of the study. The decision was therefore made to give the Sequential Tests of Educational Progress (STEP) published by Educational Testing Service of Princeton, New Jersey, to fourth-grade children only and to depend on the subjective evaluation of third-grade teachers for indications of change in pupil growth of their groups.

Selection of this test was based on its attempt to measure problem-solving skills built around situations where information gained either through previous experiences or found in the described situations could be used in reasoning through a possible solution. Separate forms of the STEP Science Tests were administered at two different times during the relatively short period of the television series, one near the beginning and the other at the conclusion. Inasmuch as a few teachers (17) did not return or gave the same form both times, the results reported are based on the returns from the 61 teachers who administered both forms.

Table 11 shows the individual and combined group mean scores of the boys and girls tested, using the national norms provided by the test publishers. As shown in the difference in the mean of the winter and spring mean scores for the combined groups (4.4), little significant gain was found to have taken place during the intervening period between the giving of the first and the second tests. This was to be expected and can be accounted for as a result of the relatively short time between the actual giving of the two tests (approximately 4 months). The test was not given at the very beginning of the study, as had been intended, because of wrong answer sheets which were sent with the tests. No control was exerted over the time tests were actually given, this being left to individual teachers to schedule as time permitted. Some teachers indicated children found the reading difficult and also questioned the validity of some of the interpretations or possible answers children were required to consider in relation to certain test situations. There is the possibility this method of testing and evaluating is not a reliable or valid procedure for determining the effectiveness of the television programs as designed for pupils yet seen as intended to be of primary value to teachers.

Again, teacher utilization of the telecasts, their individual interpretation of problem-solving abilities, and their ways of encouraging these behaviors operationally through learning activites make for more consistent growth on the part of pupils. The results of the testing do show that pupils can and do perform certain skills related to problem-solving. To say that the televised science programs indirectly did or did not contribute to their development is brought outthrough a comparison made of the differences in the mean of the two tests for individual class groups. It was found groups varied from a negative five (5.0) to a positive twenty-six (26) in terms of a decrease or increase in the mean score of the two tests, with the average increase in the mean of the second test about five points higher. Also to be noted is the mean score of the combined group for the winter test (249.5), which compares very favorably with the national average school mean of 242, as indicated in the publisher's norms.

Another point to be noted, though not significantly indicated, is that while boys and girls did about equally well on both tests and showed about the same amount of gain in achievement, as shown in the difference in the mean, the girls showed a slightly higher mean score

Table 11

Scores on a Standardized Science Test Given Before and After Telecasts

	Winter			Spring			
	Number tested	Mean	Percentile Rank	Number tested	Mean	Percentile rank	Difference in mean
Boys	879	248.9	65	879	253.6	73	4.66
Girls	803	250.4	70	803	254.3	78	3.92
Combined Groups	1,682	249.5	67	1,682	253.9	75	4.4

for the winter and spring tests, even though the boys showed a greater over-all gain. Even though these differences are very slight, their presence may raise a question as to the validity of the assumption sometimes expressed by teachers that girls are not as interested in science as boys nor can or should be expected to achieve at the same level.

In terms of the results of the testing, no definite conclusions seem possible at this time. However, this does not negate the possibilities of the televised science programs either directly or indirectly contributing to the further development of problem-solving abilities. There is the possibility this method of testing and evaluating does not lend itself as a reliable or valid approach for determining the effectiveness of the television medium per se.

If recognition is given to individual differences and the levels of achievement to be found in the groups sampled at the beginning of the study, it would seem some contribution was made toward the development of such skills, though how much is difficult to determine by this method of testing.

E. EVALUATION BY PRINCIPALS AND SUPERVISORS

At the close of the study, evaluation forms were sent to coordinators of instruction, supervising principals, curriculum consultants, and elementary school principals of the participating schools. This form had no specific statements to react to but provided space to express reactions and observations on the value of the series.

A total of 49 replies was received from this group. All expressed a high appreciation for the study in terms of enrichment of science learning in the classroom. Many felt that as the result of the series the instruction in those classrooms receiving the programs was better than those with no television instruction. Teachers became acquainted with the use of science materials different from those already available in the classrooms. Several mentioned increased requests for science equipment and indicated that, while some was obtained during the study, more will be available in the year ahead.

Administrative procedures differed in schools with regard to viewing the programs, with the number of sets and room facilities determining the number of groups viewing the programs. Many principals and supervisors indicated that they preferred single viewing groups when possible. Some had rooms set up for television viewing and others used auditoriums. Some respondents stated they would provide better facilities for small group viewing as money and space became available.

Many pointed out the increased confidence of their teachers in planning and working in the area of elementary science through finding out more about how children learn, about problem-solving techniques, and about the many roles of the teacher in determining the effectiveness of the science program.

Some mentioned the parental interest shown through encouragement given to children to do further study and experimentation at home and in the purchase of reference materials and actually in working with children on science experiments.

There was a frequent mention of the value of having the series continue over a longer period of time so that a more complete evaluation could be made. A good many principals and supervisors also testified that, if they had been able to observe classroom activity more frequently, they could have been more objective in their comments.

The general design of the telecasts, with emphasis on raising questions for the teachers and children to answer through further inquiry and study, was acceptable. One of the principals wrote, "By putting science concepts into a broader context of interpretations, the programs have definitely been of value as a consultant service to teachers." Another stated, "The suggestive teaching rather than direct teaching was helpful, in that it gave the teacher an opportunity to identify existing interests of children and identify new interests... which contributed to making science in the classroom more interesting, functional, and creative."

There was a concern about the frequency of telecasts, with many indicating a preference for weekly or bi-weekly telecasting over daily programs, especially if the program is to be a "resource medium to be supplemented with good classroom discussions and experiences."

Many expressed appreciation of the positive values to be gained from educational television, for both teachers and children, feeling that the needs of both could.be served at the same time. Some felt that more specific guidance with emphasis on fewer activites would have been beneficial; however, the programs as designed and presented were felt to respect the person-to-person relationship between teacher and pupils in the teaching-learning process and to preserve the teacher's place in making decisions as to the directions to be taken in providing the best science experience for children.

The following are representative comments by principals and supervisors:

> We felt the science programs were very worthwhile and effective. I am sure that the programs have improved science teaching. The manuals were especially good and helpful. This was an important factor in making the programs a success.

The television programs created and instigated much enthusiasm in our school. Without question our pupils and teachers performed more effectively in our science program than in other years. I noticed more concrete learning through pupil participation.

Mrs. ____ tells me that she is now more aware of the potential offered by the subject, science. The lessons correlated well with our present text. We felt the television teacher was very fine for the television group. He stimulated, demonstrated, challenged and left pupils with ideas for "carry over work." A few teachers thought the materials were covered too rapidly, while others said it was so easy to understand. Generally speaking this has been a valuable experience for our school.

The use of television by more than one group of children does not provide for the best use of the experience. A better situation in which the children would be stimulated to the greatest degree would be the use of a television set by one class at a time, and, if possible, within its own classroom situation.

It was an excellent program, well set-up, nicely televised and interestingly presented. Mr. Skelton, the instructor, has good rapport with the children. The methods of the lesson were instructionally sound. They presented understandings to be searched and summaries at the end. They were aimed to stir interest and not answer the questions. We received volumes of material to help us.

My reactions: Keen interest in the telecasts themselves; enthusiastic participation in post-telecast discussions; the children brought much in the way of pictures, experiments, home-made apparatus, and results of further study. Over all, I would evaluate the experiment as successful. Naturally, it like other tools, depends for its success upon the pre-and post-work done by the classroom teacher. There we were fortunate.

There was a great deal of enthusiasm shown by the children. This was due to seeing the televised experiments with suggestions for activities to be done by themselves, observations they could make, and also charts they could make. The teachers were especially impressed with the manual, with the program notes, and suggested activites following each program.

Although more content was developed than the class was able to use, the programs were of much value as a guide to further study and in solving many of the childrens' own questions or problems.

Chapter IV.
CONCLUSIONS AND RECOMMENDATIONS

The object of this study was to explore the effectiveness of two-purpose television programs in (1) contributing to increased teacher understanding of elementary science and (2) stimulating pupil activity in this field. The study originated in a concern for finding new avenues of communication for meeting the in-service needs of teachers.

Certain basic assumptions related to this use of television were involved:

1. Teachers will increase in a feeling of competence toward science teaching as they become more familiar with how children learn science.

2. Televised programs so designed that the emphasis goes to how science is learned can be of interest to pupils as well as to teachers.

3. Consultant service provided by television can thus be addressed simultaneously and successfully to both teacher and pupils.

In exploring these assumptions, 10 half-hour telecasts were prepared on topics approved by the 151 teachers of third- and fourth grade classes who joined the study on a voluntary basis. These telecasts, sent to classrooms at two-week intervals, were subject to evaluation in a variety of ways. Teachers sent in a reaction following each telecast and also made a final evaluation of the series. Principals and supervisors connected with the schools in which teachers received the programs also made a final evaluation.

Other efforts at judging the value of the telecasts as a two-purpose medium of affecting teacher and pupil behavior included before and after measures of the level of teacher competence as felt by teachers and the knowledge of science on the part of pupils. Also, a teacher rating of pupil problem-solving behavior was administered in the middle and at the close of the series.

The conclusions reached in the study are presented under two headings: (1) conclusions related to the question asked at the beginning of the study, "How effective can a series of televised programs in elementary science be in both increasing teacher understanding and stimulating pupil activity?" and (2) conclusions regarding the use of television for providing consultant services for in-service education.

How effective was the series in increasing teacher understanding and stimulating pupil activity? These conclusions seem to be warranted:

1. As a result of the experience, teachers increased significantly in their feeling of competence in handling science in the elementary classroom. Their greatest increase was in the physical science area, which was also where they had originally indicated greatest lack of confidence.

2. Teachers professed a willingness to accept such consultant service via television in other areas as well as in elementary science and expressed throughout a high degree of appreciation for the opportunity to gain understandings in this particular fashion. There was no overt expression of resistance to the idea of being educated along with their children nor any question raised about the possiblity of this use of television for in-service education as being or becoming an invasion of professional privacy.

3. Teachers expressed a high degree of appreciation throughout their experience and at its conclusion for the concrete help the programs provided. This help came in a variety of ways:

a. Teachers valued highly learning more about the wide range of possible learning activities in science.

b. They valued the suggestions for making science equipment from easily available and inexpensive materials.

c. They valued the success of the programs in arousing pupil interest.

d. They valued the open-endedness of the programs as a stimulus to further pupil activity.

4. Teachers evaluated all the programs as being high in pupil interest although varying according to the topic and methods of presentation. They were able to observe significant growth in pupil problem-solving behavior between the time of their first systematic observation midway through the series and the time of their second observation at the end of the series. Other evidences of pupil response to the programs were found by teachers in less measurable ways. These included:

a. Increased home interest in science activites, following up on studies begun in the classroom.

b. Materials brought from home for class use as a result of stimulus from the programs and their classroom follow-up.

c. Increased breadth and range of questions asked by children.

5. Pupil growth in achievement as measured by the standardized test selected for use with fourth-grade pupils was not significant nor was any attempt made to compare the growth of the experimental groups with control groups. The lateness in administering the test and its nature were judged as relating to this lack of much measurable achievement.

6. Despite their high degree of acceptance of the series, teachers expressed some fairly well-defined misgivings that merit attention:

a. The length of the programs was questioned, particularly by many third-grade teachers. Half an hour was felt by some to be longer than necessary or desirable.

b. Some teachers expressed concern about the density of content and suggestions in some of the programs.

c. Teachers were well agreed that the use of the series had not resulted in the increase of needed or useful science equipment in the cooperating schools.

d. Teachers varied in their reaction to how often the telecasts should have been aired. A good many felt they had not had time to complete a given study before another topic was being proposed by the series.

What conclusions can be drawn regarding the use of television for providing consultant services for in-service education? These seem to be warranted from the study:

1. The two-purpose programs as designed by this study provided new and useful experiences to many teachers who would not otherwise have had such experiences made available to them.

2. The programs were accepted by teachers and used in a great variety of ways, being adapted as was intended to the differing needs and interests of both teachers and pupils.

3. The programs demonstrate an alternative use of supervisory or consultant service which can reach great numbers of teachers in their classrooms and affect their ways of working with children.

4. The programs as accepted and used by teachers demonstrate that emphasis on ways of learning ("How Can We Find Out?") or on the processes of teaching science can be interesting to children as well as significant to teachers.

Finally, from this study, there are several recommendations for further exploration of the use of television for in-service education.

1. In the first place, it is obvious that reliance upon television to accomplish the total job of in-service education is unwarranted. That possibility was never in the picture of the present study but perhaps the doubt ought to be formally expressed.

The uses of television in in-service education, both through such two-purpose programs as the present study involved and though telecasting programs to teachers at school, at in-service centers, or at home, needs to be thought out carefully and related to the kinds of supports desirable to make sure that full use of the medium has been made. In general, it would seem likely that television should be seen as a new medium to be added to others in ways that are strengthening to the total program.

2. As far as the two-purpose use of television is concerned, it would seem desirable to try out a variety of kinds of programs that may be useful to both teachers and pupils. In this study, the series was focused on ways of learning science (experimenting, observing, constructing, recording, and reading, as well as reflecting). In another series, the focus might be on such a resource for learning as study trips. Another aspect of experimenting with such programs would be timing. This series came at two-week intervals. Such programs might be more valuable spaced at monthly intervals. Or another series, with a different focus, might be offered at weekly intervals over a shorter period of time.

3. A third set of concerns for further study can be grouped around learning how to use television. Teachers themselves need help in understanding the best ways to use the kind of programs offered by this series. Direct teaching may already have set certain expectations or habits of approach that may need reexamination when the purpose is different. Also, a number of teachers reported that the children themselves come to think of television as self-contained and regard it as a source of more or less discrete experiences. Helping children approach television in another frame of mind may be a problem for study.

4. Evaluation of the effects of such short-term approaches to in-service education may also be worth further study. The evaluation of individual programs proves of value chiefly in planning those yet to be produced. General evaluation of a program series by teachers themselves has certain values and many drawbacks, as far as obtaining evidence about effectiveness in action. In this study, the measure used to obtain evidence about changes in the feeling of confidence teachers have about science teaching seems to have been highly useful. There may be other less obvious ways to approach measurement in such studies.

5. Similarly, evaluation of such programs in terms of pupil growth is complex. The short period of time and the uncertainty about

what are the greatest values to be looked for among the results (or even when to look for them) cause any measures to be questionable. The use of the observation shcedule in this study seemed to be most promising; but in a different context, perhaps one in which such a series would be combined with small-group conferences with supervisors and consultants, better ways of measuring changes in pupil behavior might be defined.

6. The use of the kinescopes made from the series in this study could be tested for its value in pre-service education. Each of the 10 programs includes many ideas about how to develop science understandings with children and could possibly become a valued adjunct to the already available resources for pre-service education.

Investigator ________________ Date Dec. 27 1960

Supervisor Alexander Frazier Date Dec. 27 1960

For The Ohio State University Research Foundation

Executive Director Oram C. Woolpert AS Date 1/19/60

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APPENDIX A

HOW DO I FEEL ABOUT TEACHING SCIENCE?

It seems to be generally agreed that most elementary school teachers feel less confident about the teaching of science than they do about teaching the "three R's." Part of this may be the result of the less adequate preparation of the teacher in science; part may come from the feeling of the teacher himself that he is inadequately prepared to teach science.

This questionnaire is designed to measure how confident you may feel in various situations involving several aspects of elementary science teaching and will be re-administered at the conclusion of the television series to determine whether or not you have changed in your feeling of confidence with regard to science teaching.

Please indicate your feelings with respect to the situations on the following pages by circling the appropriate number before each item on the answer sheet. For example, if you feel "very confident" about a certain situation, circle the number 5; if you feel "moderately confident" circle the number 4; and so on, utilizing the code shown below:

(5) Very confident
(4) Moderately confident
(3) Uncertain
(2) Moderately unconfident
(1) Very unconfident

SITUATION A

Your class is doing a unit on "Animals." The children ask the question, "How are plants and animals alike?" Below are some possible activities which you and the class may do. How confident would you feel about each?

1. Have children observe pets and plants at home to see how they are similar in basic needs.
2. Take the class on a field trip to notice the variations in plants and animals.
3. Do experiments to see if both plants and animals need water, food, etc.
4. Discuss with the class some of the similarities and differences between plants and animals.
5. Provide reference lists of children's books on plants and animals.

SITUATION B

A fourth-grade teacher is just a little afraid to do experimentation with her class. One day she attempted to demonstrate how the body derives calcium from food. She had one of the pupils blow air through a straw which was immersed in a glass of lime water. The carbon dioxide in the pupil's breath should have made the calcium precipitate out and turn the water a milky color. However, much to the class's delight, the lime water stayed clear and the calcium did not precipitate. Below are some possible activities which could be undertaken. How confident would you feel about each?

6. Do the experiment over again using a new solution of lime water.
7. Discuss suggestions from the class to determine what was the reason for the failure in the experiment.
8. Try another experiment which will show the same body process as the one which failed.

9. Discuss some other related experiments which attempt to show the same results as the one which failed.

10. Encourage reading by children to discover possible reasons for failure in the experiment, provide reference materials for them to use.

SITUATION C

Your class is working on a unit study in "How do plants grow?" Below are some possible activities which may be carried out by the children and the teacher. How confident would you feel about each?

11. Read in books about plants and how they grow.

12. Observe a plant in a box or container to record growth changes.

13. Do experiments to show how a plant seed germinates.

14. Provide a list of references of children's books.

15. Have a sharing discussion about plants that children have in their homes.

SITUATION D

Your fourth grade class is studying a unit on weather. The question is raised, "How does the weather man know it's going to rain?" In looking at these possible activities, how confident would you feel about each?

16. Construct and use a model barometer or other equipment used by the weather man.

17. Use science kit to conduct experiments to determine causes of precipitation, condensation, etc.

18. Encourage children to read in reference materials to find information about weather (books, magazines, weather reports, etc.)

19. Help the children design and follow through with a daily weather chart.

20. Form a committee to investigate the question further and provide a list of resource materials for committee use.

SITUATION E

Your class is doing a unit study in "How simple machines help us." Below are some possible activities which may be carried out by the children and the teacher. How confident would you feel about each?

21. Observe the ways that simple machines are used in the school or community and record results of observations.

22. Provide a list of children's books on the uses of simple machines.

23. Discuss with the class the basic principles behind the workings of a pulley and some of its practical uses.

24. Have a sharing and discussion period about children's toys which resemble simple machines.

25. Discuss some of the uses of similar simple machines such as the lever, inclined plane, ball bearings, etc.

SITUATION F

While on a field trip, the school bus passes through an area where corn is planted. It has been a rainy year, and some of the corn fields are flooded in spots, and the corn is dying. The children, discussing the trip the next day, raise the question, "We have always been told that water is needed for plant life; why is the corn dying? It has plenty of water." In terms of the activities, how confident would you feel about each?

26. Discuss some experiments which the class may do to determine some of the requirements of plant life, and some conditions which may harm plants.

27. Do experiments with different kinds of plants (corn, water cress, wheat, bean, etc.) to show that each of them have slightly or greatly different environmental requirements for ideal growth.

28. Form a committee for further investigation of the problem; provide appropriate reference materials for them to use.

29. Have children observe plants in their homes and gardens to determine effects of the environment on the plants.

30. Make an observational chart of some local plants which live in the water, others which live on dry land. Observe local plants and record results.

SITUATION G

Your classroom is doing a unit study on the solar system. Below are some possible teacher-pupil activities. How confident would you feel about each?

31. Plan a trip to a nearby observatory or planetarium.

32. Find information about the solar system in materials other than the text which would be at an appropriate reading level for the children.

33. Design an observation chart of the visible planets. Observe the visible planets and keep a record of their positions in the night sky.

34. Construct a model of the solar system using balls, marbles, or beads to show the approximate relative sizes of the sun and the planets.

35. Have a class discussion on the importance of the sun.

SITUATION H

Your classroom is working on a unit study of "Electricity and what it can do." Below are some possible activities which may be carried out by the children and the teacher. How confident would you feel about each?

36. Construct a model electric motor from inexpensive materials.

37. Do experiments to show how a light bulb works.

38. Dismantle old or broken appliances to observe and learn more about how they work.

39. Provide a list of references of children's books on the uses of electricity.

40. Discuss some of the ways electricity is used in the school.

ANSWER SHEET: HOW DO I FEEL ABOUT TEACHING SCIENCE?

SITUATION A

Very confident to very unconfident

(1)	5	4	3	2	1
(2)	5	4	3	2	1
(3)	5	4	3	2	1
(4)	5	4	3	2	1
(5)	5	4	3	2	1

SITUATION B

(6)	5	4	3	2	1
(7)	5	4	3	2	1
(8)	5	4	3	2	1
(9)	5	4	3	2	1
(10)	5	4	3	2	1

SITUATION C

(11)	5	4	3	2	1
(12)	5	4	3	2	1
(13)	5	4	3	2	1
(14)	5	4	3	2	1
(15)	5	4	3	2	1

SITUATION D

(16)	5	4	3	2	1
(17)	5	4	3	2	1
(18)	5	4	3	2	1
(19)	5	4	3	2	1
(20)	5	4	3	2	1

SITUATION E

Very confident to very unconfident

(21)	5	4	3	2	1
(22)	5	4	3	2	1
(23)	5	4	3	2	1
(24)	5	4	3	2	1
(25)	5	4	3	2	1

SITUATION F

(26)	5	4	3	2	1
(27)	5	4	3	2	1
(28)	5	4	3	2	1
(29)	5	4	3	2	1
(30)	5	4	3	2	1

SITUATION G

(31)	5	4	3	2	1
(32)	5	4	3	2	1
(33)	5	4	3	2	1
(34)	5	4	3	2	1
(35)	5	4	3	2	1

SITUATION H

(36)	5	4	3	2	1
(37)	5	4	3	2	1
(38)	5	4	3	2	1
(39)	5	4	3	2	1
(40)	5	4	3	2	1

APPENDIX B EVALUATION REPORT ON TELECASTS

PROGRAM NO. AND TITLE ____________________ TEACHER ________________________

SCHOOL ____________________ GRADE___

Please check in the appropriate places your reactions as well as the reactions of the group.

1. General level of interest to telecast as a whole? Excellent___, Good___, Fair___, Poor___
2. Degree of interest level during program? Sustained throughout___, At no time___, As program progressed___, Less as progr progressed___, Some specific part _____ (Indicate)________________________
3. General interest level higher with: Boys than girls___, Girls than boys___, About even___
4. Pace of program? Too slow___, About right___, Too fast___
5. Kinds of activities or experiences presented invoking greatest interest? Experimental___, Observational___, Reading___, Discussion___, Other________________________
6. Appropriateness of content to maturity level of children? Above___, Below___, Satisfactory___, Very well chosen___
7. Effectiveness of experiences in contributing to concept development? Excellent___, Good___, Fair___, Poor___
8. Vocabulary level for children? Above___, Below___, About right___
9. Effectiveness of telecast in encouraging further discussion, planning, and exploration in science? (children) Excellent___, Good___, Fair___, Poor___
10. Organization of program through question and partial answer - Is enough given so you can continue? Excellent___, Good___, Fair___, Poor___
11. Effectiveness of telecast in giving ideas and lead to follow-up in teaching science (teacher)? Excellent___, Good___, Fair___, Poor___
12. Range and variety of experiences on telecast to meet individual differences? Excellent___, Good___, Fair___, Poor___

13. Number of ideas or problems explored on telecast were: Excessive___, About right___, Too few___

14. Rapport of television teacher with children? Excellent___, Good___, Fair___, Poor___

15. Effectiveness of pre-telecast questions? Excellent___, Good___, Fair___, Poor___

16. Usefulness of suggestions to teacher in manual? Excellent___, Good___, Fair___, Poor___

17. Value of suggested activities for for children in manual? Excellent___, Good___, Fair___, Poor ___

18. Quality of television production--in visualizing materials? Excellent___, Good___, Fair___, Poor ___

LOG OF SCIENCE ACTIVITIES

To be returned by the time of next telecast.

Television Topic: ______________________

One of the important kinds of information needed to evaluate the effectiveness of the science television series, is the kinds of involvement and the nature of the activities carried on following the bi-monthly telecasts. We would like you to briefly describe, what are to you significant experiences and activities of the group. We have indicated certain headings to describe the activities. This in no way means that each space must necessarily be filled in. The experiences you plan will obviously vary. The headings are the kinds of experiences being stress on the program, and we are interested in finding out the degree of involvement in relation to them.

Experimentation: (Experimental activities and construction of equipment for use in experiments)

Observation: (Observation experiences of the environment; keeping records of observations)

Reading: (Using books, other printed materials, films and film strips to find information.)

Discussion: Oral activities, sharing experiences, discussing findings, etc.

Other Types of Activities:

Additional Remarks: (Thinking and behavioral changes, problem-solving abilities, attitudes, etc.)

Teacher's Name

School

APPENDIX C:

Teacher of Children: **Evaluation of Behavior in Science**

Note: Will you please respond by indicating the number following the particular word which best interprets your observation.

None (1), Little (2), Some (3), Frequently (4), Consistently (5).

Now		End of Study
___	Enjoying searching for answers and showing a natural desire for a logical explanation of things and events occurring around them?	___
___	Trying to relate and apply their present information, incorrect as it may be, to logically think through problems, observations, experiments, and other activities carried on?	___
___	Using a variety of sources of information?	___
___	Questioning and making choices between sources of information?	___
___	Seeing the importance of explaining things and making decisions on the basis of fact rather than opinions or unfounded beliefs?	___
___	Labeling their sources of information as a basis for authenticity of statements made?	___
___	Willing to consider new ideas and change theirs in light of new evidence?	___
___	Questioning the statements of others and accepting the questioning of their own statements?	___
___	Seeing the value of working for further evidence before drawing conclusions?	___
___	Showing growth in the manipulation and use of science materials in solving problems?	___
___	Becoming more resourceful in suggesting ways of finding out, planning and carrying out an experiment or other designated responsibility?	___
___	Showing an ability to use science information and previous learnings in new situations?	___
___	Seeing the importance of accuracy in experiments, observations, procedures, recordings, etc.	___
___	Reporting things done out of school or at home and bringing them to share with the group?	___
___	Finding parents interested and revealing this interest through reports of how parents have helped them?	___